POTENTIAL USE OF FUTURES MARKETS IN INTERNATIONAL MARKETING OF CÔTE D'IVOIRE COFFEE

by

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TABLE OF CONTENTS

List of Tables

List of Figures

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Chapter 1

Introduction

Coffee holds a very unique and important position in international commodity trade. Currently, total coffee exports are about $13 billion a year and affect over 25 percent of the total foreign exchange of many of the Less Developed Countries (LDCs) including Côte d'Ivoire (formerly Ivory Coast). Great fluctuations in coffee prices over the years have resulted in an instability in LDC export revenues and have caused concerns among producing nations.

The strategies employed in solving the coffee problem have in general concentrated on reducing price variability through export restrictions implemented by International Commodity Agreements. But these measures too often have limited success as they cannot totally control variations in quantity supplied. Hence, major price fluctuations still characterize the coffee market.

Several investigators have suggested active participation of LDCs producers in futures markets (Thompson, Petzel) as a means of improving their export performance and a way to ensure price stability and more stable export revenues. Although many conditions, both real and imagined (ignorance, fear, cost), have kept LDCs from successfully

using the futures markets, a better understanding of futures trading and greater recognition of the potential net benefits of hedging may increase the use of futures markets as a tool in international trade.

1.1. Importance of the Study

As a third world coffee producer, Côte d'Ivoire relies heavily on coffee export earnings in pursuing development plans. But erratic movements in international coffee prices result in major fluctuations in foreign exchange earnings even in the presence of International Commodity Agreements (ICAs). Thus, coffee market price uncertainty jeopardizes the country's planning efforts.

Price fluctuations have always been a part of the coffee history and remain a noticeable phenomenon even today. According to the FAO (Food and Agricultural Organization) prices deflated by the IMF (International Monetary Fund) index of consumer price in industrial countries, coffee prices continuously showed a tremendous volatilily. For example, in 1977, Robusta coffee prices hit a record high of 293.59 cents per pound. Prices went down one year later to 180.46 cents per pound in 1978 before falling further to 93.90 cents in 1981. By 1983, coffee prices were however on the rise and reached 100.16 cents per pound that year. The average annual Robusta prices, from 1961 to 1983, calculated from the same FAO

sources was 115.87 cents per pound while the coefficient of variation in average annual coffee prices in the international market over the same period was 43.46 percent. Export earnings from Côte d'Ivoire reported by the FAO showed earnings of $13.2 million in 1977, $6.6 million in 1978, $3.4 million in 1981, and $3.9 million in 1983. The coefficient of variation in annual coffee revenues over the twenty-three year period was 64.13 percent. Coffee volume exported has known some fluctuations although of a lesser degree than the fluctuations in earnings. Exports were 4.5 million bags in 1977, 3.7 million bags in 1978, 3.6 million bags in 1981 and 3.9 million bags in 1983.

These significant factors point out the nature of the problem any coffee producer and in our case, Côte d'Ivoire, is faced with, and explain why it is important that Côte d'Ivoire seeks marketing strategies that will assist in stabilizing its export earnings from coffee. Price and revenue instability are urgent problems.

Increasing research attention has already been given to analysis of the benefits that futures trading might provide to the LDCs upon their active participation in the market. In particular, price and income stabilization potential of the futures market has already been explored. The possibility of shifting price risk to speculators by hedging has been proposed many times (e.g. Peck, Thompson). Several hedging strategies are identified in the literature. They include

insurance hedging, storage or inventory hedging, and more recently, forward or anticipatory hedging.

Within this array of possible strategies, anticipatory hedging, "hedging carried out to maximize expected returns for a given risk," (Thompson 1985) sounds most viable for the LDC risk-averse coffee producer. Shifting of price risk may permit Côte d'Ivoire to achieve some increase in short-run stability of coffee earnings, thus enhancing its ability to make financial commitments for development planning.

1.2. Objectives of the Study

The general objective of this research is to evaluate the use of futures trading as a way to reduce income instability from international sale of coffee for Côte d'Ivoire as a representative of coffee producing countries.

The specific objectives of the study are as follow:

1. To determine random, seasonal, annual, and cyclical price variation in world coffee markets.
2. To determine supply and demand conditions for Côte d'Ivoire export coffee (Robusta) and for competing products (Arabica, Brazilian Milds) that have affected price variation over the years.

3. To determine the price impact of changes in institutional conditions governing world price formation on the coffee market.

4. To identify and test strategies for use of futures markets as a tool to minimize negative impacts of variations in world coffee prices on revenue patterns from Côte d'Ivoire coffee export.

1.3. Outline of the Study

The introductory first Chapter will be followed in Chapter 2 by a review of applicable recent literature on futures markets and the role of futures markets in international trade in coffee.

Given the importance of coffee for the economies of many LDCs and its importance in international trade, an overview of the world coffee market structure and behavior and the origins and characteristics of the coffee industry problems will be presented in Chapter 3.

In Chapter 4, Côte d'Ivoire is chosen as a typical African coffee producer to show the impact of coffee on a specific less-developed economy.

Chapter 5 will introduce the futures markets and their hedging opportunities with specific references to coffee trading on the two most active markets - New York and London.

Chapter 6 will present the theoretical model of an optimal hedge using a mean-variance framework and the results will be reported and interpreted.

Finally, Chapter 7 will close the thesis as we draw the conclusions and make certain recommendations.

Chapter 2

Literature Review

2.1. Early Development of Futures Trading

Active futures markets exist for a great variety of commodities today. But when futures first arose more than a hundred years ago, they were confined to agricultural and metal products only.

2.1.1. Forward Contracts and Futures Contracts

According to Anne Peck (1985), the forward markets for grain (corn and wheat) that existed in Chicago in the second half of the nineteenth century were responsible for the emergence of the futures market as it is known today. No specific date, says the author, can be attached to the beginning of "organized futures markets" because their development was evolutionary. The futures market is viewed and defined as a "standardized forward market". With a standardized sales unit and specified delivery conditions, the only item to be negotiated when buying or selling a futures contract is price. A forward contract in general permits individual buyers and sellers to agree on a future transfer of a commodity on terms, including price, that are mutually

convenient. Buyer and seller assume full responsibility vis-á-vis each other, while in a futures contract, there is a third party involved. That third party is the clearinghouse. The clearinghouse in a futures market assures the settlement of contracts. It assumes the position of buyer to each seller and vice-versa. Therefore, all the parties involved in a futures contract are responsible vis-á-vis the clearinghouse rather than to each other.

In general, futures markets and forward markets, as well as physical markets are complementary to each other as they all three still remain important. Physical or cash markets are for immediate delivery markets at spot price. Forward markets allow traders to mutually agree on specific terms to the future delivery of the commodity. Futures markets are standardized forward markets where only price is negotiable. Futures markets are growing in importance for diverse commodities.

2.1.2. Expansion in Futures Markets in the 1970s

Futures markets originated with continuously storable commodities. Early literature on the most important role plausibly played by futures markets focused on the hedging of inventories. Gray and Rutledge (1973) referred to Working's price of storage theory (1969) as the "culmination" of the inventory hedging view of futures markets. Working

contended that the cash/futures price differential (positive or negative) reflected a true price of storage for continuous inventory commodities.

Recent developments have, however, shifted analytical approaches to other allocative and stabilizing functions of the futures markets. Other than traditional storable commodities have come to play an increasing role in the market and have shown the evolution of futures trading in adapting to new commercial needs.

2.1.2.1. Non-Storable Commodities

According to Gray and Rutledge the evolution of trading in egg futures at Chicago provided a good illustration of the altered role of futures trading. The egg futures market which first emerged as an inventory hedging market "par excellence" soon gave rise in 1967 to a fresh egg futures contract enabling forward price hedging in a situation where inventory no longer was at stake. Similarly, introduction of futures markets in potatoes and onions encountered some opposition as reported by Gray and Rutledge, partly because they didn't fit the "traditional mold." They were not as continuously storable as wheat or corn.

In more recent years, the trading mechanisms and contract rules of trading have adapted to an expanded demand for new services. Very active trading exists in futures

contracts in markets as diverse as live cattle, live hogs, chicken and even financial instruments.

2.1.2.2. Financial Futures Markets

Financial Futures are divided into three groups: foreign currencies, interest rate contracts, and stock index futures.

The first financial futures contracts on foreign currencies in the U.S.A. were introduced in 1972 in Chicago, followed by interest rate futures in 1975 and by stock index futures in 1982. Foreign currency futures are traded on the International Monetary Market (IMM) which is a division of the Chicago Mercantile Exchange (CME). The most commonly traded foreign currencies on the U.S. Exchange are: the British pound, the Canadian dollar, the Japanese yen, the Swiss franc, and the West German mark (Table 2.1.).

For most financial futures, as for most storable commodities in general, the main contribution of futures markets remains the price discovery and hedging functions available as instruments of risk reduction. On the other hand, financial futures markets promote greater liquidity than do cash markets and thus allow the management of risk at reduced transaction costs.

TABLE 2.1.

MAJOR FINANCIAL FUTURES CONTRACTS, 1972–1984

Contract	*Exchange*	*Began Trading*
Foreign currencies		
British pound	IMM	1972
Canadian dollar	IMM	1972
Japanese yen	IMM	1972
Swiss franc	IMM	1972
West German mark	IMM	1972
Interest rates		
Treasury bills	IMM	1976
Bank CDs	IMM	1981
Eurodollars	IMM	1981
GNMAs	CBT	1975
Treasury bonds	CBT	1977
Treasury notes	CBT	1982
Stock index		
Major Market index	CBT	1984
NYSE composite	NYFE	1982
S&P 500	CME	1982
Value Line	KCBT	1982

NOTES: CBT = Chicago Board of Trade; CME = Chicago Mercantile Exchange; IMM = International Monetary Market (Division of CME); KCBT = Kansas City Board of Trade; NYFE = New York Futures Exchange; and NYSE = New York Stock Exchange.
SOURCE: *Wall Street Journal* listing of futures contracts.

William L. Silber, " The Economic Role of Financial Futures," in Futures Markets: Their Economic Role, ed. Anne Peck Washington D.C. : (American Enterprise Institute for Public Policy Research, 1985)

Although the cash markets for most financial instruments are well organized and highly liquid, the financial futures markets, because of their economic benefits have shown a considerable growth and account today for almost 50 percent of all futures trading (Silber 1985).

2.2. Market Functions of Commodity Futures

Futures markets have been frequently referred to as close models of the competitive markets so often read about in economic theory books. Because traders on the futures market have approximately equal access to price information, use of this information remains crucial in maintaining the integrity of the price discovery function attributed to commodity futures. Tomek and Robinson (1981) recognized the importance of the price discovery function of futures markets. However, these authors attached greater importance to the hedging function, describing hedging as the "main economic justification for futures markets".

A very simple definition of hedging given by the authors is "establishing a position in the futures opposite from the one held in the spot (cash) market." A citation of Working (1953) as quoted by Tomek and Robinson defined a hedge as:

> the use of a futures contract as a temporary substitute for a later transaction in the cash market. A selling hedge starts with the sale of futures contracts, and a buying hedge starts with the purchase of contracts.

One objective of hedging is to protect oneself against the risk of negative price fluctuations by shifting risk to speculators. Gray and Rutledge in their review of literature on futures trading came to categorize four classes of hedging theory. They are

1. "Hedging carried out to eliminate the risk associated with price fluctuations," which the authors qualify as a naive concept, related to the very old view of insurance hedging.
2. "Hedging carried out to reduce the risks associated with price fluctuations" might be the attitude of those traders who accepted risk reduction as a major function of hedging.
3. "Hedging carried out to profit from movements in the basis" which raised early objections from Working.
4. "Hedging carried out to maximize expected returns for a given risk (variability of return) or minimize risk for a given expected return." In this category, the authors cited the works of Markowitz, who has developed the Mean-Variance model as a portfolio selection tool.

Although Gray and Rutledge acknowledged that not all the discussions of hedging theory clearly fell into any of the four classes, the classification nevertheless represents the hedgers' different motives.

2.3. Basis Risk Vs. Price Risk

Working (1953) has been often cited for his emphasis that most hedging does not have the objective of pure risk aversion or pure price insurance. Hedging only reduces price risks but another risk remains for the hedger to deal with, and that is the basis risk. The basis is the differential between a futures price and a cash price. Ordinarily the basis narrows as the delivery month is approached, and it approaches zero at the delivery point at the end of the delivery month. For Rhodes (1983), in hedging, the price level doesn't matter; only basis matters. In commodity markets, fluctuations in the basis are almost always less than fluctuations in commodity prices thus price risk can be reduced by hedging. In an over-simplified situation, basis may be assumed to be constant, so that any negative price movement in the cash market resulting in a loss is matched by a gain in the futures market. In the real world, basis variation may occur totally independent of changes in commodity price levels. In extreme cases, the basis may be inverted, meaning that the cash price rises above the futures price to the disadvantage of the short hedger.

2.4. International Use of Futures Trading

Futures trading extends today to commodities traded internationally with some of the major ones, including coffee, produced mainly in the less developed countries. The well established futures markets exist in the developed countries with the U.S.A. being the most active trading center. But the participation of LDCs has been very limited despite the potential benefits of futures market reported by academicians. For example, Thompson (1985) listed potential benefits of flexibility in pricing, support of commodities prices, and of course anticipatory hedging and inventory hedging.

In fact, all the benefits associated with futures markets as well as the availability of market information are said to apply to the LDC exporter and active participant in the market. It is "unfortunate," indicated Petzel (1985) that "LDC exporters who frequently have highly informed traders, do not give them either access to financial resources or freedom from institutional burdens that would allow the countries to benefit from effective hedging." It seems nevertheless that a number of factors are responsible for the reluctance of LDCs to use the futures markets effectively. These limiting factors have been identified by Thompson to be:

1. LDC exporters' skepticism of futures markets as some see them as biased in favor of developed countries, because of their geographic location and delivery point.
2. LDC exporters' perception of speculation as responsible for price instability and of speculators as evil.
3. Certain LDCs fear that futures trading may be too risky.
4. For other LDCs, it is the cost involved with trading futures that is repulsive, since one needs extremely liquid financial reserves to maintain a futures position.

In addition to these legitimate apprehensions, exchange rate risk remains important and according to Thompson and Bond (1985) "will influence the extent to which offshore hedgers participate in futures transactions whenever spot and futures prices are perceived to interact with exchange rate over time." To reduce the risk associated with exchange rate fluctuations, Thompson (1985) suggests the LDC concurrently hedge in foreign markets if there exists an active forward market for the LDC's currency.

Although some of the factors cited and especially exchange rate risk may influence the desirability of futures trading for LDCs, Thompson still believes that LDCs can successfully use the futures market to "forward price anticipated exports" and also benefit from the flexibility in the pricing of exports afforded by the futures. The author, however, warns that the use of futures markets will not completely eliminate variability in export revenues as revenue

instability is caused by variability in quantity as well as prices. This price and quantity uncertainty that characterize most LDC's commodities have been taken in consideration by Rolfo (1980) as he studies the optimal hedging level of a cocoa producer. His results contrast with Peck's (1975) which apply to a potato producer faced only with price variability. Rolfo found that a 100 percent hedge would not be desirable for his risk-averse cocoa producers.

Hedging as a risk-reducing marketing instrument and a tool for income stabilization is gaining more support among scholars (Gordon and Rausser 1984). The most important thing about hedging, affirms Scheu (1973) is to carefully analyze what the business objectives are, and then decide to what extent it would be acceptable to take on market risk. Thus "hedging carried out to maximize expected returns for a given risk (variability of return) or minimize risk for a given return" appears a reasonable attitude to Gray and Rutledge (1971).

Some chances for successfully using the futures market will be guaranteed if, following the advice of Thompson (1985), government trading agencies are the main traders because of their greater chances of procuring foreign exchange than private firms in order to meet the financial requirement of the futures market.

Chapter 3

The World Coffee Economy

3.1. General Background on Coffee

Coffee is a tree plant grown principally in less developed countries, whereas consumption of coffee is mainly concentrated in the Developed Countries (DCs). As a commodity, coffee holds a unique position in international trade and has been found to be second only to crude oil as an earner of foreign exchange to the majority of the producing countries (Singh et al. 1977). However, coffee traded on the international market is not a homogeneous commodity. The two widely grown species are known as Arabica and Robusta, which are further subdivided into specific varieties.

The coffee plant (Robusta and Arabica) is usually grown from seed and if allowed to grow, can reach 8 meters in height (approximately 26 feet). The tree begins to bear within three to five years but does not produce in commercial quantities until the sixth or seventh year. Depending on the variety and growth conditions, the productive life of mature trees varies from fifteen to forty-five years.

These particular conditions pertaining to coffee production result in variable and inelastic short-run supply conditions and are undoubtedly partially responsible for the

basic economic problems of the coffee industry, particularly the swings in prices. Furthermore, both price and income demand for coffee are fairly inelastic. Aggregate world price elasticity of demand has been estimated by Singh et al. (1977) at about - 0.25, prompting the authors to conclude that an over-supply of coffee may not cause consumption to increase greatly. They also found an income elasticity of only 0.536. The short-run (one year) price elasticity of supply was low and reported to be 0.09 for all the coffee producing regions (Singh et al. 1977) because of the three to five year lag in coffee tree production.

According to the authors, both the short-run and the long-run elasticity of supply will be low in countries where agriculture is devoted largely to coffee cultivation and where production comes mostly from smallholders. In countries where coffee is only of minor importance for the economy and/or estate holdings dominate the coffee sector, short-run supply elasticity will be higher. In the long-run, the estate sector will show a higher supply elasticity in response to higher prices only if the country has plenty of land available for the estate holder to expand faster.

3.1.1. Arabica Coffee

Arabica is grown mainly in Brazil and in other Latin American countries as well as parts of Africa. Fifty-eight of

the seventy-nine major coffee producing countries are largely specialized in Arabica production. Arabica is grown at higher elevations, usually 2,000 to 5,000 feet. The ideal range of temperature is between 17.5° C (65° F) to 22.5° C (75° F). Arabica is severely damaged by frost or by drought conditions resulting in major supply impacts when these conditions occur. Roughly 70 percent of the coffee consumed worldwide is Arabica (Appendix A). For marketing purposes, Arabica is further divided into washed Arabicas or Milds and unwashed Arabicas known as Brazils. Washed Arabica refers to coffee for which cherries are depulped immediately and the beans placed in water to facilitate later removal of the mucilage, whereas unwashed Arabica refers to the coffee cherry that has been dried and then depulped to free the beans.

On the market, washed Arabica or Milds are further divided into "Colombian Milds" and "other Milds" and rank first in quality as represented by price because of their mild flavor (Table 3.1.). Brazils rank second and constitute a good substitute for both Milds and Robustas. The soft Santos coffees are generally considered the best grown in Brazil.

3.1.2. Robusta Coffee

Robusta belongs to the Coffea canephora specie and is grown mostly in the tropics including Africa. It does well

TABLE 3.1. COMPARISON BETWEEN GROUP INDICATOR PRICES OF OTHER MILD ARABICAS AND ROBUSTAS; ANNUAL AVERAGES 1965 TO 1984

Year	Other Mild Arabicas	Robustas	Difference col. (1)-(2) Cents	As % of col.(1)	As % of col.(2)
	(1)	(2)	(3)	(4)	(5)
1965	45.31	30.58	14.73	32.51	48.17
1966	42.12	33.53	8.59	20.39	25.62
1967	39.20	33.52	5.68	14.49	16.95
1968	39.33	33.86	5.47	13.91	16.15
1969	39.78	33.11	6.67	16.77	20.14
1970	52.01	41.44	10.57	20.32	25.51
1971	44.99	42.27	2.72	6.05	6.43
1972	50.33	45.19	5.14	10.21	11.37
1973	62.30	49.88	12.42	19.94	24.90
1974	65.84	58.68	7.16	10.87	12.20
1975	65.41	61.05	4.36	6.67	7.14
1976	142.75	127.62	15.13	10.60	11.86
1977	234.67	223.76	10.91	4.65	4.88
1978	162.82	147.48	15.34	9.42	10.40
1979	173.53	165.47	8.06	4.64	4.87
1980	154.20	147.15	7.05	4.57	4.79
1981	128.23	102.61	25.62	19.98	24.97
1982	140.05	109.94	30.11	21.50	27.39
1983	132.05	123.90	8.15	6.17	6.58
1984					

Note: Indicator Prices 1968 until September 1976, Indicator Prices 1976 from October 1976 to September 1981 and Indicator Prices 1979 thereafter

Source: International Coffee Organization

at low altitudes (2,000 feet down to sea level) and under temperatures averaging 22° C (74° F) to 26° C (82° F). High regular rainfalls, 1,500 mm (60 inches) to 1,800 mm (72 inches) per year are necessary for the wellbeing of the plant.

Robusta accounts for 80 percent of African production. It is priced lower on the international market than Brazils or Milds (Table 3.1.). However, the price gap has narrowed over the years. Robusta prices averaged 36 percent below Columbian in the 1960s and only 26 percent below Columbian Milds prices in the 1970s. Robusta has a stronger flavor and higher amount of caffeine than Arabica varieties. Milds (the highest priced coffee) and Robustas are poor direct substitutes for each other although Brazils may substitute for either Milds or Robusta. Thus market impacts of supply variation by specie occur. According to Geer (1971),

> under given conditions and habits of consumption, the demand for Brazils in roasted coffee depends on the price differential between Brazils and Milds on the one hand and Brazils and Robustas on the other. A shrinkage in the price differential between Brazils and Milds will lead to a reduction of Brazils in a mild blend. A widening of the price differential will promote a substitution of Brazils for Milds, but only to such extent that the taste barrier will not be crossed. If the price differential between Brazils and Robustas narrows, then a substitution of Brazils for Robustas will occur.

In recent years, Robusta has seen its production and demand increase because it has proven to be better suited for soluble coffee than are Arabica varieties. World coffee

production by species is reported in Tables 3.2. In Table 3.3. the increase in market share of Robusta coffee at the expense of Arabica is apparent.

3.2. World Coffee Distribution and Trade

3.2.1. Trends in World Coffee Production

Coffee has a very particular place in world trade. All the coffee production is concentrated in Africa, Latin America, and Asia in areas generally characterized as economically underdeveloped. On the other hand, 92 percent of the coffee consumption is concentrated in the developed countries.

The three largest producers account generally for 47 to 48 percent of world production (Table 3.4.). The figures for the 1984/85 season were: Brazil (30 percent), Colombia (12 percent), and Côte d'Ivoire (5 percent). The largest importers for the same season were the United States (30.5 percent) and the EEC (European Economic Community; 48.15 percent) (Table 3.5.).

Coffee is extremely sensitive to weather conditions, i.e. frost and drought in the producing countries, especially in Brazil. These two weather factors have immensely influenced the supply of coffee over the years and subsequently prices and the revenues of the producers.

TABLE 3.2. WORLD COFFEE PRODUCTION (1,000 60-kg. bags)

Crop Year	Arabica	Robusta	Other	Total
1960/61	52,415	12,719	235	65,369
1961/62	64,125	11,562	248	75,935
1962/63	53,461	14,066	253	67,780
1963/64	49,005	16,069	245	65,320
1964/65	38,407	13,978	256	52,641
1965/66	65,646	16,226	265	82,137
1966/67	47,856	15,210	267	63,333
1967/68	52,974	17,869	268	71,112
1968/69	44,807	18,152	267	63,226
1969/70	51,033	18,285	274	69,592
1970/71	41,570	17,550	258	59,378
1971/72	55,087	17,941	252	73,280
1972/73	57,270	19,746	221	77,237
1973/74	46,095	19,387	228	65,710
1974/75	63,146	19,302	245	82,693
1975/76	55,509	17,305	249	73,062
1976/77	42,944	17,885	238	61,067
1977/78	54,406	16,089	201	70,696
1978/79	59,888	18,884	206	78,978
1979/80	62,270	19,292	227	81,789
1980/81	68,264	22,760	237	86,261
1981/82	75,216	22,734	239	98,189
1982/83	59,342	22,338	237	81,917
1983/84	71,127	17,122	246	88,495
1984/85	65,454	26,061	252	91,767
1985/86	72,121	24,071	255	96,447
1986/87	56,800	25,859	276	82,935

Source: USDA Horticultural and Tropical Products

TABLE 3.3. PERCENTAGE DISTRIBUTION OF WORLD COFFEE PRODUCTION BY SPECIE

Crop Year	Production (1,000 bags)	Arabica	Robusta	Other[1]
		-------Percent-------		
1960/61	65,374	80.3	19.3	.4
1965/66	82,157	79.9	19.8	.3
1970/71	59,426	70.0	19.5	.5
1975/76	73,109	76.0	23.7	.3
1980/81	86,344	73.3	26.4	.3
1983/84	90,359	78.7	20.9	.4
1984/85	93,608	73.4	26.3	.3

[1]Mainly Liberica
Source: USDA Horticultural and Tropical Products

TABLE 3.4. COFFEE, GREEN: TOTAL PRODUCTION IN SPECIFIED COUNTRIES
AVERAGE 1977/78, ANNUAL 1982/83-1986/87
(IN THOUSANDS OF 60 KILO BAGS)

REGION AND COUNTRY	AVERAGE 1977/78-1981/82	1982/83	1983/84	1984/85	1985/86	1986/87
NORTH AMERICA, CENTRAL AMERICA & CARIBBEAN:						
COSTA RICA	1,728	2,300	2,070	2,516	1,514	2,200
CUBA	317	300	385	325	375	350
DOMINICAN REP.	941	1,100	610	909	780	910
EL SALVADOR	3,074	2,800	2,400	2,680	2,225	2,375
GUATEMALA	2,674	2,530	2,340	2,703	2,640	2,950
HAITI	518	674	630	592	579	633
HONDURAS	1,254	1,500	1,310	1,400	1,088	1,600
JAMAICA	23	30	25	25	32	35
MEXICO	3,737	4,530	4,530	4,250	4,480	4,660
NICARAGUA	975	1,257	710	800	700	675
PANAMA	115	238	150	201	225	250
TRINIDAD-TOBAGO	41	23	30	30	35	30
UNITED STATES	207	267	201	279	248	257
TOTAL NORTH AMERICA	15,504	17,449	15,592	16,710	14,921	16,925
SOUTH AMERICA:						
BOLIVIA	130	155	150	140	150	150
BRAZIL	22,800	17,750	30,000	27,000	33,000	13,900
COLOMBIA	12,841	13,300	13,000	11,000	12,000	12,400
ECUADOR	1,598	1,800	1,380	1,500	1,997	2,100
GUYANA	22	21	17	15	12	12
PARAGUAY	129	271	280	240	275	250
PERU	1,143	1,100	1,270	1,150	1,250	1,300
VENEZUELA	1,064	791	1,025	1,213	992	1,100
TOTAL SOUTH AMERICA	39,717	35,188	47,122	42,258	49,676	31,212
AFRICA:						
ANGOLA	554	330	260	260	250	250
BENIN	17	30	55	55	25	25
BURUNDI	437	340	593	460	550	500
CAMEROON	1,675	1,830	1,000	2,316	1,602	2,025
CENT. AF. REP.	217	316	150	250	300	300
CONGO	54	32	35	25	25	25
COTE-D' IVOIRE	4,418	4,510	1,420	4,609	4,333	4,700
EQUAT. GUINEA	13	15	15	15	15	15
ETHIOPIA	3,190	3,350	3,300	2,600	3,100	3,150
GABON	8	29	35	40	25	30
GHANA	32	23	20	15	15	15
GUINEA	80	65	50	30	85	80
KENYA	1,475	1,541	2,000	1,493	2,087	2,000
LIBERIA	153	159	80	215	70	105
MADAGASCAR	1,175	1,000	1,100	1,200	1,300	1,250
MALAWI	5	16	27	35	60	75
NIGERIA	49	45	42	48	50	50
RWANDA	436	377	536	542	600	600
SIERRA LEONE	160	233	180	200	145	215
TANZANIA	894	1,033	643	895	900	810
TOGO	152	284	275	215	275	275
UGANDA	2,186	3,000	2,700	2,800	2,700	3,000
ZAIRE	1,338	1,354	1,350	1,540	1,800	1,620
ZAMBIA	2	3	7	10	13	16
ZIMBABWE	78	117	147	180	188	200
TOTAL AFRICA	18,798	20,052	16,220	20,044	20,513	21,331
ASIA:						
INDIA	2,177	2,170	1,667	3,250	2,033	2,700
INDONESIA	4,930	4,750	5,515	5,600	5,800	5,800
MALAYSIA	118	145	154	160	150	150
PHILIPPINES	813	1,225	973	1,111	1,150	1,250
SRI LANKA	50	64	58	74	78	78
VIET NAM	67	60	60	60	60	60
THAILAND	176	324	364	470	519	500
YEMEN	54	57	50	53	50	50
TOTAL ASIA	8,385	8,795	8,841	10,778	9,840	10,588
OCEANIA:						
NEW CALEDONIA	9	6	4	6	6	6
PAPUA-N. GUINEA	809	648	939	774	873	900
TOTAL OCEANIA	818	654	943	780	879	906
WORLD TOTAL	83,222	82,138	88,717	90,574	95,829	80,962

1/ Coffee marketing year begins about October in some countries and April or July in others. 2/ 132.276 pounds.

NOTE: Production estimates for some countries include cross-border movements.

SOURCE: Prepared or estimated on the basis of official statistics of foreign governments, other foreign source material, reports of U.S. Agricultural Attaches and Foreign Service Officers, results of office research, and related information.

January 1987 Foreign Production Estimate Division, FAS/USDA

TABLE 3.5. IMPORTS BY IMPORTING MEMBERS FROM ALL SOURCES
OCTOBER-SEPTEMBER 1980/81 TO 1985/86

(000 bags)

Importing Member	October-September					
	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86
TOTAL	59 390	60 884	62 383	63 337	64 142	66 866*
U.S.A.	18 005	18 623	18 479	19 629	19 527	21 090
E.E.C.	28 728	29 294	30 758	29 695	30 889	30 969
Belgium/Luxembourg	1 983	1 764	1 842	1 952	2 125	1 894 1/
Denmark	1 136	1 110	1 024	1 007	987	1 015
France	5 800	5 783	5 974	5 696	5 832	5 477
Germany, F.R. of	8 567	9 123	9 240	9 209	9 006	9 491
Greece	434	448	454	457	533	424 1/
Ireland	65	71	81	97	110	114
Italy	3 838	4 056	4 099	3 790	4 497	4 643
Netherlands	2 720	2 550	2 813	2 647	2 815	2 763
Portugal	208	249	300	316	330	346 1/
Spain	1 516	1 577	2 286	1 966	1 886	2 165 2/
United Kingdom	2 461	2 564	2 645	2 558	2 766	2 617 3/
Other importing Members	12 658	12 966	13 145	14 013	13 726	14 806
Australia	646	725	698	679	705	667
Austria	837	1 039	1 150	1 040	1 067	1 185
Canada	1 994	1 875	1 806	1 840	1 881	1 966 2/
Cyprus	37	33	39	92	33	30 2/
Fiji	3	3	3	2	1	1
Finland	895	1 178	1 010	1 072	1 132	874
Japan	3 200	3 493	3 772	4 287	4 130	4 569
New Zealand	110	105	122	112	111	103
Norway	713	744	711	794	709	744
Singapore	693 4/	492 4/	638 4/	980	921	1 134 4/
Sweden	1 652	1 747	1 639	1 717	1 646	1 622 2/
Switzerland	1 092	1 017	1 059	1 035	1 133	1 165
Yugoslavia	786	517	499	365	257	740

Due to rounding the totals may not always reflect the sum of the relevant components
* Preliminary
1/ Estimated
2/ Includes estimates provided by the Member
3/ Provisional
4/ Includes estimated imports from Indonesia

Source: ICO

World coffee production averaged 32.6 million bags from 1950 to 1955 (USDA estimates). Coffee prices were very high following World War II, causing massive coffee tree planting following the war and in the early 1950s. By the early 1960s, these plantings came to full production, overflooding the market and pushing coffee prices down.

World coffee production reached 65.4 million bags in marketing year 1960/61 which was double the 1950 to 1955 average. Production reached a peak of 82.2 million bags in 1965-66. After 1965, production trended downward to 58.9 million bags in 1970/71 but rebounded to 82 million bags again in 1974/75. Production has remained at 80 million bags or more each year since 1980. The highest annual world production was recorded in 1982 with world production of 98 million bags (Table 3.6.). In ten years, 1977 through 1986, annual world production varied from 70.7 million bags to 98.2 million with an average of 85.4 million bags.

Coffee is mainly traded as green beans to be transformed into roasted coffee, ground coffee, and soluble coffee (i.e. instant coffee) by the importer. Soluble coffee is gaining popularity and some exporters have engaged in processing but it still accounts for less than 5 percent of the total producers' exports (Table 3.6.). In 1986/87, soluble exports accounted for 4.3 percent of total coffee exports, compared to only 1.8 percent, eighteen years ago in 1968/69. There is potential for an enlarged share of the soluble coffee

TABLE 3.6.

WORLD : COFFEE SUPPLY & DISTRIBUTION 1960/61-1996/87
(IN THOUSANDS OF 60 KILOGRAM BAGS)

CROP YEAR	BEGINNING STOCKS	PRO- DUCTION	IMPORTS	TOTAL S/D	DOMESTIC USE	BEAN EXPORTS	RSTD/GRND EXPORTS	SOLUBLE EXPORTS	TOTAL EXPORTS	ENDING STOCKS
1960/61	58,840	65,375	339	124,554	16,388	42,842	63	92	42,998	65,169
1961/62	65,169	75,943	304	141,416	21,086	45,956	56	135	46,147	74,183
1962/63	74,183	67,788	288	142,259	14,705	46,776	42	123	46,941	80,613
1963/64	80,613	65,330	263	146,206	17,729	50,912	69	118	51,100	77,377
1964/65	77,377	52,651	217	130,245	16,706	41,826	58	78	41,962	71,577
1965/66	71,577	82,147	369	154,093	17,823	49,746	37	257	50,040	86,230
1966/67	86,230	63,344	419	149,993	19,298	48,451	26	564	49,041	81,655
1967/68	81,655	71,123	393	153,171	18,083	54,724	55	741	55,521	79,568
1968/69	79,568	63,237	363	143,168	19,650	52,626	76	963	53,665	69,954
1969/70	69,854	69,603	387	139,844	18,903	54,032	83	1,161	55,276	65,665
1970/71	65,665	59,390	485	125,540	19,385	50,515	112	1,253	51,880	54,276
1971/72	54,276	73,292	479	128,047	19,070	56,550	249	1,589	58,388	50,588
1972/73	50,588	77,249	442	128,279	17,466	59,042	346	2,040	61,428	49,385
1973/74	49,385	65,729	569	115,683	19,028	58,278	192	2,149	60,619	36,035
1974/75	36,035	82,726	468	119,229	19,181	53,248	235	1,985	55,468	44,580
1975/76	44,580	73,107	428	118,115	19,194	57,229	371	2,164	59,765	39,157
1976/77	39,157	61,161	534	100,852	18,417	54,190	351	2,176	56,717	25,718
1977/78	25,718	70,677	618	97,013	18,780	47,662	183	897	48,742	29,491
1978/79	29,491	79,035	677	109,203	19,436	61,994	222	2,433	64,649	25,118
1979/80	25,118	81,837	648	107,603	19,942	59,250	218	2,573	62,041	25,620
1980/81	25,620	86,318	671	112,609	20,511	56,941	167	2,821	59,929	32,169
1981/82	32,169	98,240	765	131,174	21,145	60,818	223	4,064	65,105	44,924
1982/83	44,924	82,138	773	127,835	20,829	62,317	202	2,490	65,009	41,997
1983/84	41,997	88,717	678	131,392	21,300	65,133	340	2,774	68,247	41,845
1984/85	41,845	90,574	529	132,948	23,594	68,935	315	3,353	72,603	36,751
1985/86	36,751	95,829	541	133,121	21,961	66,604	461	2,556	69,621	41,539
1986/87	41,539	80,962	633	123,134	22,003	62,909	368	2,855	66,132	34,999

January 1987

Horticultural and Tropical Products Division
Commodity Programs FAS/USDA

market by the exporters if some existing trade barriers in the importing countries were lowered.

3.2.2. Trends in World Coffee Consumption

The demand for coffee is concentrated in the developed countries with the U.S.A. and the European Economic Community (EEC) as the largest consumers. Coffee is mainly consumed as a beverage and has a very low price demand elasticity. Price demand elasticity averaged -0.219 over the 1950 to the estimated 1985 period in the U.S.A. (Singh et al.) at seventy cents per pound in 1967 terms. Coffee consumption is considered a habit and represents a very low share of consumer income. Elasticity of demand with respect to income varied from 0.006 in 1975 to 0.001 in 1985 (Singh et al.). The decline in income demand elasticity is linked to saturation level supposedly attained by coffee consumers.

3.2.2.1. In the U.S.A.

According to the USDA, U.S. coffee consumption was nearly 62 percent of world production in the 1950s. However, by 1965, that consumption dropped to 47.0 percent and is estimated today at 33 percent of world production. In fact, consumption in the U.S. has been declining for the past twenty-five years and a study by ICO (International Coffee

Organization) revealed that in 1986, per capita consumption was 1.74 cups per day compared to 1.83 cups in 1985 and 3.12 cups in 1962. The proportion of the population drinking coffee decreased from 54.9 percent in 1985 to 52.4 percent in 1986, while the cups consumed per drinker remained virtually unchanged (Table 3.7.).

The USDA relates the initial decreases in the U.S. coffee consumption to the high retail coffee prices during the early 1950s. That brought major shifts in consumer tastes, and the introduction of soluble coffee further reinforced the decline in per capita green bean consumption. Soluble coffee was substituted for regular coffee and went from 10 percent of total consumption in 1953 to 21 percent in 1965 (USDA). In 1965 solubles were yielding seventy cups per pound of coffee, compared with only 51.5 cups for regular coffee, hence their increased share of total consumption. On the other hand, soluble coffee suffered most of the decline occurring in U.S. coffee consumption in 1986. Today, regular coffee continues to be the type most frequently consumed by U.S. drinkers, accounting for nearly eight out of ten cups consumed (Table 3.7.).

3.2.2.2. In the Rest of the World

The EEC stands first in world coffee consumption with 48 percent of world imports. Although there is variation

TABLE 3.7. COFFEE CONSUMPTION IN THE U.S.A.

	Rate of Consumption			
	1962	1984	1985	1986
Cups per person per day	3.12	1.99	1.83	1.74
Cups per drinker per day	4.17	3.48	3.33	3.32

Source: ICO

TYPE	Percentage Drinking			
	1962	1984	1985	1986
All Coffee	74.7	57.3	54.9	52.4
Regular	59.3	39.4	39.1	39.0
Soluble	23.5	22.5	19.4	16.4

SOURCE: ICO

in individual EEC member coffee import performance, there has been a slight increase in the whole EEC import in general (Table 3.8.). The United Kingdom, where coffee is competing with tea as the national beverage, and West Germany have seen their imports rise remarkably these last years.

In general, in most western European countries, the growth of coffee consumption is slowing down as saturation levels are about to be reached. On the other hand, potentials for consumption growth exist in other parts of the world, like Japan and Eastern Europe, and offer new markets for the coffee producing countries.

3.2.3. Coffee Exports and National Economies

In the producing countries, coffee is a major part of the gross national product (GNP) and as an export product, it is one of the main sources of foreign exchange earnings. For example, in 1978, USDA data show coffee representing 15.4 percent of Brazil's total exports, 65.2 percent for Colombia, and 25 percent for Côte d'Ivoire (Table 3.9.).

According to Singh et al. and based on 1970-72 data, eighteen[1] countries depended on coffee for more than 25 percent of their foreign exchange earnings and "in 1972-74,

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[1]Portuguese Timor, Burundi, Uganda, Colombia, Rwanda, Ethiopia, Haiti, El Salvador, Yemen, Guatemala, Cote d'Ivoire, Angola, Costa Rica, Brazil, Equatorial Guinea, Kenya, Madagascar, Cameroon

TABLE 3.8. INDEX OF IMPORTS

OCTOBER-SEPTEMBER 1979/1980 = 100

	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84
EEC	105	100	106	107	111	108
of which						
France	105	100	103	103	106	101
West Germany	100	100	107	114	116	115
Italy	97	100	101	107	108	100
U.K.	131	100	108	112	116	112

Source: African Coffee, November 1985

TABLE 3.9. COFFEE: EXPORT VALUE AS PERCENT OF TOTAL EXPORTS, 1974–78
(In percent)

Continent and country	1974	1975	1976	1977	1978
North America					
Costa Rica	28.3	19.6	26.0	39.2	35.2
Dominican Republic	5.9	3.9	12.4	21.7	13.1
El Salvador	41.5	32.9	52.9	62.0	34.2
Guatemala	30.2	26.3	32.0	44.3	—
Haiti	33.6	22.8	37.4	44.4	—
Honduras	16.7	19.3	25.6	33.3	35.4
Mexico	5.4	6.4	12.0	10.5	6.2
Nicaragua	12.1	9.8	22.0	31.2	30.9
South America					
Brazil	10.9	9.9	21.5	19.0	15.4
Colombia	43.9	45.8	55.4	61.6	65.2
Ecuador	6.0	6.5	15.3	13.1	18.8
Peru	2.3	3.9	8.5	11.7	9.1
Venezuela	0.2	0.2	0.5	0.6	—
Africa					
Cameroon	24.8	19.4	36.3	34.0	29.7
Ethiopia	27.8	34.0	56.7	75.5	72.9
Côte d'Ivoire	26.7	29.6	33.8	37.5	25.0
Kenya	23.6	20.9	34.7	42.5	33.7
Madagascar	26.7	22.3	42.9	48.8	—
Tanzania	14.8	19.0	33.6	41.0	35.8
Uganda	73.3	77.8	85.8	92.8	—
Asia and Oceania					
India	1.9	1.5	1.7	2.5	3.6
Indonesia	1.3	1.4	2.8	5.5	4.2

—Denotes unknown
Source: January 1980, Commodity Programs, FAS/USDA

when the total export earnings of developing countries for primary commodities other than oil were estimated at approximately $47,000 million, the value of their exports of coffee was $3,700 million," i.e. 7.8 percent.

All of the coffee export dependent countries are developing countries with many of them having annual per capita incomes of less than $200 and low rates of growth of gross national product (GNP). Latin America is the dominant coffee producer with 60 percent of world production, Africa accounts for 30 percent, and Asia and Oceania produce the remaining 10 percent. Currently, total coffee exports are about $13 billion a year (ICO data) for over 66 million bags sold.

Instability in the revenues of the coffee producing countries is to be attributed not only to the fluctuations in the price of coffee exports but to the volumes exported as well. For many coffee producing countries, coffee represents a high proportion of total exports, making the producers more vulnerable to the disturbances in the market which will have a negative impact on their domestic economy.

Between 1950 and 1970, world coffee production grew at a rate of just under 3 percent a year but the real value of coffee grew by only 0.6 percent a year, according to FAO data. Following the sharp rise in prices after World War II, massive new plantings took place and by 1960, the coffee market was over-supplied and prices fell drastically. However, in the

1950s as a whole, production had already expanded by about 75 percent (Singh et al.). The growth in world coffee exports followed a somewhat similar pattern owing very much to stocks held in producing countries to match demand. Thus, coffee stocks rose continuously until 1966 and as production fell later in the 1960s, due to the diversification policies pursued by Brazil, stocks were intensively used and declined rapidly. Prices which had begun to recover slowly, boosted suddenly as Brazil experienced a severe frost in 1975. It should be noted that large stocks of coffee were in existence in the producing countries throughout the 1960s and in 1966 total producer stocks reached a peak of 86 million bags, equal to nearly two years of world import demand (Table 3.6).

In general, coffee can be stored for two to three years with only a marginal deterioration in quality. In hot and humid climates, air-conditioned warehouses are required for storage. In general, coffee could be considered a continuously storable commodity although coffee that has been in storage for five years or more has always been diverted to the domestic market especially in Brazil, while the more recent growths are used for exports. All the producing countries, with the exception of Brazil, export almost all of the coffee they grow. Consequently the shares of most countries in the world export market roughly correspond to their shares in total production. In the particular case of Brazil, up to 1973, the world's largest producer was able to

maintain a 30 percent share in the export market despite its smaller share (20 percent) in the world exportable production (i.e. production minus domestic consumption) because of its stock-holding policy.

Value increased as volume increased but at a lower rate and influenced the movement of world export value. Export unit values reached a high in the mid-1950s, declined rapidly toward the early 1960s, and have grown since at a somewhat irregular pace, on the average more or less reflecting the growth in export volume (Table 3.10.). Generally, the gain in export earnings has come from larger volumes rather than from higher unit values. Real prices of coffee, deflated by the 1980 IMF (International Monetary Fund) index of consumer prices in the industrial countries, increased rapidly after World War II. When consumption was higher than production and stocks were reduced to their lowest point in the early 1950s, prices rose to a peak of 258 cents per pound in 1956 on the New York spot market for Colombian coffee. Thereafter, prices began to decline when large supplies, triggered by the high prices, came on the market and stocks began to increase dramatically. Prices reached a low of 124 cents in 1962 one year before the International Coffee Agreeement (ICA) came into effect. With the establishment of the ICA, all the producers were hoping to see prices rise again as a consequence of the export controls. Their expectations were realized when prices increased to 141 cents in 1964 despite

TABLE 3.10. INDEXES OF VALUE AND VOLUME OF WORLD COFFEE EXPORTS FROM PRODUCING COUNTRIES, 1959-70
(1960 = 100)

Year	World	Central America	South America	Africa	Asia & Oceania
			Value of Coffee Exports		
1959	102	90	105	103	116
1960	100	100	100	100	100
1961	97	90	97	96	133
1962	98	99	94	107	128
1963	105	93	101	120	171
1964	126	116	111	172	179
1965	117	118	103	152	181
1966	126	121	106	182	209
1967	119	104	101	170	269
1968	135	114	117	191	251
1969	129	114	111	182	254
1970	124	117	101	159	256
			Volume of Coffee Exports		
1959	102	92	105	102	93
1960	100	100	100	100	100
1961	103	98	100	103	181
1962	105	112	102	99	161
1963	118	106	113	122	206
1964	109	111	95	133	145
1965	105	109	87	133	187
1966	118	115	100	147	202
1967	121	111	103	142	286
1968	129	124	112	158	216
1969	128	119	112	154	245
1970	168	130	126	218	352

Source: Trade yearbooks 1952-69, Vol. 8-24, Rome Italy. USDA "World Demand Prospects for Coffee in 1970," Daniel Timms.

still existing large coffee stocks. However, prices eventually fell again to low levels at the discovery of ample coffee supply and in 1968, real prices were even lower than their 1962 level (Table 3.11.).

It is that erratic movement of prices characteristic of the coffee market over the years that has almost "forced" the producers to organize themselves. The creation of the International Coffee Organization (ICO) in late 1962 was a result of the willingness to join marketing efforts to solve the coffee problem.

3.3. World Coffee Organization and Marketing

In search of solutions to halt the decline in the coffee industry, the producers came to associate within the International Coffee Organization (ICO).

However, several other regional and inter-regional producers' organizations had preceded ICO in an attempt to solve the coffee problem with more or less success and remain of historical importance.

TABLE 3.11. COFFEE: WHOLESALE PRICES (cents/lb.) AND SUPPLY DISTRIBUTION*

Year	Columbian Manizale[1]		Brazilian Santos 4[1]		Robusta[2]		Product.	Total export	Ending stocks	Index[3] (1980=100)
	Current	Const.	Current	Const.	Current	Const.				
1954/55	64.6	230.7	57.1	203.9	40.5	144.6	42,188	29,219	13,831	28.0
1955/56	74.0	258.7	58.1	203.1	38.2	133.6	50,348	38,296	17,476	28.6
1956/57	63.9	216.6	56.9	192.9	40.5	137.3	45,420	36,203	18,241	29.5
1957/58	52.3	170.9	48.4	158.2	41.8	136.6	55,009	37,340	27,410	30.6
1958/59	45.2	145.8	37.0	119.4	31.8	102.5	61,565	39,126	40,149	31.0
1959/60	44.9	142.1	36.6	115.8	31.8	100.6	77,988	42,500	63,637	31.6
1960/61	43.6	135.8	36.0	112.1	30.5	95.0	65,375	42,998	65,169	32.1
1961/62	40.8	124.0	34.0	103.3	30.9	93.9	75,943	46,147	74,183	32.9
1962/63	39.5	116.9	34.1	100.9	28.2	83.4	67,788	46,941	80,613	33.8
1963/64	48.8	141.0	46.7	135.0	35.9	103.8	65,330	51,100	77,377	34.6
1964/65	48.5	136.2	44.7	125.6	31.4	88.2	52,651	41,962	71,577	35.6
1965/66	47.4	128.5	40.8	110.6	35.5	96.2	82,147	50,040	86,230	36.9
1966/67	41.8	110.0	37.8	99.5	35.0	92.1	63,344	49,041	81,655	38.0
1967/68	42.6	108.1	37.4	94.9	33.6	85.3	71,123	55,521	79,568	39.4
1968/69	45.0	109.0	40.8	98.8	33.6	81.4	63,237	53,665	69,854	41.3
1969/70	56.4	129.4	54.6	125.2	41.8	95.9	69,603	55,276	65,665	43.6
1970/71	49.3	107.4	44.8	97.6	40.8	88.9	59,390	51,880	54,276	45.9
1971/72	56.7	118.1	51.0	106.3	44.9	93.5	73,292	58,388	50,588	48.0
1972/73	72.7	140.6	66.9	129.4	51.3	99.2	77,249	61,428	49,385	51.7
1973/74	77.9	132.9	68.1	116.2	57.2	97.6	65,729	60,619	36,035	58.6
1974/75	81.5	125.2	82.8	127.2	61.1	93.9	82,726	55,468	44,580	65.1
1975/76	158.0	224.1	149.8	212.5	127.9	181.4	73,107	59,765	39,157	70.5
1976/77	240.7	315.1	308.6	403.9	224.3	293.6	61,161	56,717	25,718	76.4
1977/78	185.6	226.6	165.6	202.2	147.8	180.5	70,677	48,742	29,491	81.9
1978/79	183.8	205.6	178.9	200.1	165.9	185.6	79,035	64,649	25,118	89.4
1979/80	179.4	179.4	209.4	209.4	147.5	147.5	81,837	62,041	25,620	100.0
1980/81	145.6	132.5	180.0	163.8	103.2	93.9	86,318	59,929	32,169	109.9
1981/82	149.3	126.4	144.8	122.6	111.2	94.2	98,240	65,105	44,924	118.1
1982/83	142.3	114.7	143.3	115.5	124.3	100.2	82,138	65,009	41,997	124.1

* Until 1960, 1,000 bags of 132.276 pounds each. After 1960, 1,000 bags of 60 kg each.
1 Spot price New York.
2 Côte d'Ivoire, Robusta, ex-warehouse, Le Havre.
3 IMF index of consumer price in industrial countries.
Sources: FAO, Production Yearbook, various issues - USDA, Foreign Agriculture Circular, various issues.

3.3.1. Regional Organizations

3.3.1.1. In Latin America

In May 1955, the International Coffee Bureau was formed by 15 Western Hemisphere nations and the Belgian Congo. Its main purpose was to study price stabilization methods.

In October 1957, the Mexico City Agreement was signed by FEDECAME (Fédération Cafétaria Centro-Américano-Mexico et Caraibé), members of which are fourteen coffee producing countries of Central America, Mexico, and Caraibe. The attempt to limit exports in order to influence coffee prices failed.

In June 1958, the Coffee Study Group was established by thirty producing and consuming nations in Rio de Janeiro (Brazil) to seek a solution to the worsening surplus problem.

In October 1958, a short-term (one-year) coffee agreement was signed as a follow-up, incorporating provisions for export retention. However, this agreement also was a failure.

In October 1959, the Latin American group of producers opened their activities to African producers willing to accept quota restrictions.

3.3.1.2. In Africa

In December 1960, shortly after the former French and British colonies emerged as independent countries, ten African producers met in Antanarivo (Madagascar) to set the bases of IACO (InterAfrican Coffee Organization). IACO is in many regards similar to FEDECAME and has a membership of twenty-five countries.

Later on, the seven[2] IACO Francophone members created an organization called OAMCAF (Organization Africaine et Mauricienne du Café). All the seven countries speak the same official language (French) and belong to the same monetary zone (franc). The main purpose of OAMCAF is to coordinate marketing strategies of member countries and to stand as a unique and unified member of the international organizations, sharing a global quota level and adopting a common position on issues before the organization.

All these regional and multinational associations finally led the way to a greater, world-wide organization for a smoother and more general coffee policy.

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[2]The seven members are: Benin, Cameroon, Central African Republic, Congo, Côte d'Ivoire, Gabon, and Madagascar.

3.3.2. The ICO

The ICO is a world-wide coffee organization of seventy-five producing and consuming countries. The fifty exporting countries account for 99 percent of the world production and the twenty-five importing countries represent about 90 percent of world coffee consumption (Appendix B of list of members).

3.3.2.1. ICAs and Coffee Marketing

The first International Coffee Agreement (ICA) was signed in New York in 1962 and started an era of control of the coffee industry by the organization. The latest ICA, which should remain in force until September 30, 1989, was signed in 1983 and has the following principal features as defined by the elected coffee board:

(a) A system of export quotas may operate if necessary to secure stability of price within ranges agreed upon annually by exporting and importing members at meetings of the International Coffee Council.

(b) Quotas may be suspended if prices rise above certain levels and be subsequently reintroduced if prices fall. The reference level is the ICO "indicator price" based on the New York, German, French, and British exchange

prices. The composite indicator refers to the mix of both Arabica and Robusta prices.

It has been agreed to use 15-day running averages of the composite indicator as a trigger for making the changes in the quotas.

> If the indicator falls to an agreed level as shown by the 15-day average, the quota is cut by the agreed amount (perhaps a million bags, perhaps more). If the 15-day average reaches a higher trigger, the quota is increased to restrain the upward price movement. (Marshall, p.111).

Appendix C explains the 15-day running average of the ICO

(c) The quota system operates in such a way that consideration is given to past performance and to the stocks of coffee held in exporting members' countries. The size of the overall quota is fixed each September for the ensuing year, as from October 1, and adjustments apply as the year goes on and given the market supply conditions.

Conflicts over the size of market shares have already arisen as new producers are willing to expand their market share in the face of greater prices and new demand (e.g., Robusta for soluble coffee) in the oligopolistic coffee market (Table 3.12.).

3.3.2.2. ICA and Coffee Prices

The main objective of the ICO remains the stabilization of world coffee prices by pursuit of an export

TABLE 3.12. COFFEE YEAR 1984/85
ANNUAL QUOTAS REFLECTING QUOTA INCREASE WITHDRAWAL*
OF JULY 4, 1985
(in bags of 60 kilos)

Exporting Member	Revised Annual Quota
TOTAL	59,155,500
Sub-total: Members entitled to a basic quota	56,220,678
Colombian Milds	10,950,831
Colombia	8,858,421
Kenya	1,351,005
Tanzania	741,405
Other Milds	12,849,221
Costa Rica	1,220,265
Dominican Republic	516,238
Ecuador	1,180,756
El Salvador	2,438,400
Guatemala	1,889,211
Honduras	857,800
India	700,503
Mexico	1,988,065
Nicaragua	697,470
Papua New Guinea	646,567
Peru	713,946
Brazil and Other Arabicas	18,227,724
Brazil	16,777,729
Ethiopia	1,449,995
Robustas	14,192,902
Angola	270,000
Indonesia	2,501,843
OAMCAF	(7,237,551)
Benin	55,529
Cameroon	1,488,303
Central African Republic	281,160
Congo	42,211
Gabon	42,211
Ivory Coast	4,217,773
Madagascar	801,817
Togo	308,547
Philipines	488,778
Uganda	2,516,432
Zaire	1,178,298
Sub-total: Members exempt from basic quotas	2,934,822

Source: ICO

* = " Quota Increase Withdrawal" refers to in-year adjustments in members quotas.
Numbers in the Table are members final quotas for 1985.

quota policy. The successive ICAs have helped to keep the prices at a certain level over the years but could not always prevent fluctuations due to certain exogenous variables.

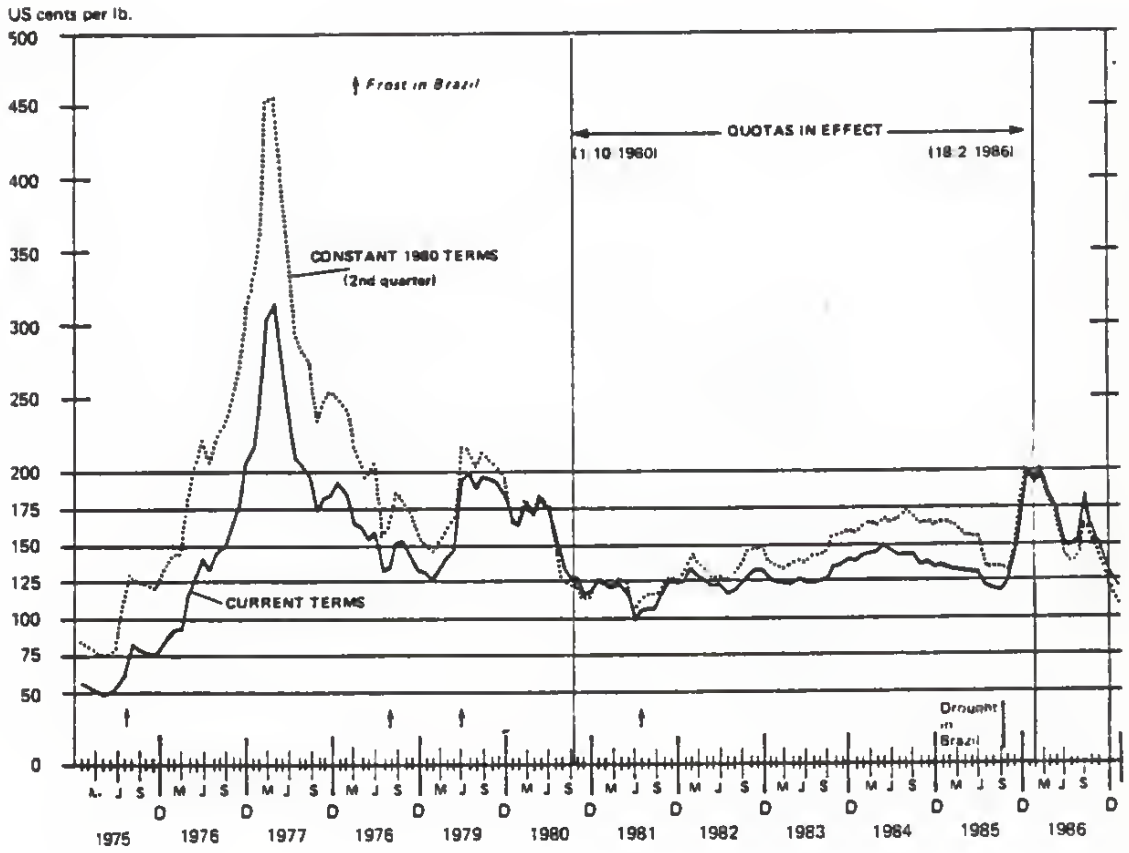
In the years preceding the 1962 ICA, i.e., the second half of the 1950s and early 1960s, the coffee market was oversupplied and prices were very low. Then came the first ICA in 1963 and prices remained stable from 1964 to 1972 with production and consumption fairly balanced (Table 3.11.).

But when the prices of all primary commodities including coffee rose again in 1973, there was a collapse of quotas. In 1975, prices went up again following a frost in Brazil and a provision in the agreement was called for allowing for quota suspension and greater flexibility in the quota system to take into account market conditions and especially strong pressure on prices. This provision is still used and has made the ICA more flexible for producers.

Despite the presence of the ICAs, there is still substantial seasonal price variation as can be substantiated by the ICO composite monthly indicator prices from 1975 to 1986. (Appendix D). Generally, a major weather event (frost or drought) in Brazil will have the consumers scared and will subsequently drive prices up the following months as in August 1975, September 1978, July 1979, August 1981, and in October 1985. Eventually, prices will fall back as stock held in the producing countries prevent supply from decreasing. (Figure 3.1.). Overall, yearly price fluctuations remained great over

FIGURE 3.1. **COMPOSITE INDICATOR PRICES**

MONTHLY AVERAGES SINCE 1975
(IN CURRENT AND CONSTANT TERMS)



NOTE: (1) Prices refer to average of Other Milds and Robustas up to September 1976, Composite Indicator Prices 1976 up to September 1981 and Composite Indicator Price 1979 thereafter.
(2) Prices in constant terms refer to prices in current terms deflated by the U.N. index of unit values of exports of manufactured goods from developed market economies. (Base: April—June 1980 = 100).

Source: ICO: Coffee Statistics

the seasons. Thus, the yearly average prices as reported in Appendix D for the seven years of the ICO data, showed a coefficient of variation of 34.29 percent. Within a single year, the variations were as high as 25.3 percent in 1975 or as low as 2.5 percent in 1984.

The indexes of seasonal variation (Table 3.13.) calculated from Appendix D ICO deflated prices, prove that there exist a seasonality in coffee prices. From January to June, prices are higher than the annual average (100). However, prices below the annual average are observed through the remaining months of the year before stabilizing at the median in December. Despite the presence of seasonality, coffee prices show a certain irregularity (see Index Table 3.13.) and fluctuate within a very large band (>12 percent). That band around the index of seasonal variation is made of an upper and lower price limits and will contain approximately 68 percent of the variation which could normally be expected to occur in the price series. The possibility of large fluctuations in coffee prices makes therefore any price forecasting a hazardous task for the coffee producer.

Thus, the coffee agreements and the ICO in general cannot control the volatility of coffee cash prices when exogenous factor such as weather is the disturbing element. Coffee is a commodity that faces inelastic demand, with an almost oligopolistic market. Brazil is indeed the largest producer and the leader followed by many small producers.

TABLE 3.13. INDEX OF SEASONAL VARIATION AND INDEX OF IRREGULARITY IN COFFEE PRICES 1975-1986

in percent

Month	Index of Seasonal Variation	Index of Irregularity	Upper Limit (1)	Lower Limit (2)	Difference (1)-(2)
Jan	100.9	7.0	107.9	93.9	14.0
Feb	101.4	7.5	108.9	93.9	15.0
Mar	103.5	9.0	112.5	94.5	18.0
Apr	103.9	7.5	111.4	96.4	15.0
May	103.1	6.9	110.0	96.2	13.8
Jun	102.2	11.2	113.4	91.0	22.4
Jul	95.2	6.1	101.3	89.1	12.2
Aug	96.7	8.9	105.6	87.8	17.8
Sep	97.6	11.4	109.0	86.2	22.8
Oct	97.5	11.7	109.2	85.8	23.4
Nov	98.0	9.5	107.5	88.5	19.0
Dec	100.0	6.3	106.3	93.7	12.6

Source: Price data from ICO Coffee Statistics.

Given these facts, agreements designed to stabilize prices through export quotas may be difficult to implement. Therefore, control and cooperation to avoid cheating is necessary and costly.

The obstacles (high volatility of the market, low supply and demand elasticity, high cheating tendency) to be defeated by the ICO are indeed great. That is why other coffee marketing techniques by LDCs ought to be considered. Futures markets and available instrument such as hedging seem good additional strategies to reduce price fluctuations within a marketing year and will be explored in the next chapter.

An optimal hedging strategy that could be used by a typical LDC coffee exporter (Côte d'Ivoire) for income stabilization purposes will thus be analyzed.

Chapter 4

Coffee and Côte d'Ivoire

Côte d'Ivoire (formerly Ivory Coast) is a developing country on the West African coast. A former French colony, it became independent in 1960 and has its economy based on agriculture and in particular the export of coffee and cocoa.

Coffee was introduced in Côte d'Ivoire by a Frenchman named Verdier in the mid-nineteenth century. First produced to satisfy the French colonial government, coffee has become, since the country's independence, the primary source of foreign exchange earnings and thus plays an important role in Côte d'Ivoire's economy.

4.1. Production

Robusta coffee is the only variety grown in Côte d'Ivoire. It is sensitive to weather as well as diseases. Coffee exports started in Côte d'Ivoire in 1913 under the colonial government and expanded rapidly after the country's independence in 1960.

Wickizer (1943) reported that Côte d'Ivoire is a good example of the rapidity with which the area under coffee can be increased. "In 1927-28 only 5,000 hectares were reported as devoted to coffee cultivation, but by 1936-37 this figure had increased to 104,000 hectares." That rapid

growth is to be attributed to the great amount of virgin land available at that period for expansion of coffee plantations. The growth in the country's coffee production has nevertheless been steady except during the 1961-62, 1966-67, and 1983-84 seasons when productions dropped because of bad weather (Table 4.1.). However, the short-run supply elasticity in Côte d'Ivoire as a mature producer is at 0.16 calculated for this study over twenty-three from FAO data and reflects the low world coffee supply elasticity in general. Production comes mostly from smallholders.

Today, Côte d'Ivoire is the third largest coffee producer in the world after Brazil and Colombia as well as the largest producer of Robusta in Africa. The country produces over 4 million bags of coffee annually. Such an important producer could not be left out of any international marketing arrangement and therefore Côte d'Ivoire is a member of the International Coffee Organization, member of OAMCAF (Organization Africaine and Mauricienne du Café), which is a sub-member of IACO (InterAfrican Coffee Organization). In that respect, the country's coffee production is regulated by quota levels set by ICO members (Table 4.2.).

Côte d'Ivoire coffee exports in 1987-88 are estimated at 4.5 million bags, about 500,000 bags above the 1986-87 level. Exports are mainly green beans; soluble exports average 5 percent while roast/ground coffee is one

TABLE 4.1.

Cote d'Ivoire

AREA, TREE POPULATION AND PRODUCTION, 1960/61-1987/88
(AREA IN 1,000 HA, TREES IN 1,000,000 AND
PRODUCTION IN 1,000 60 KILO BAGS)

BEGINNING MONTH	YEAR	AREA PLANT	AREA HARV.	BEARING TREES	NON-BEAR. TREES	TOTAL TREES	ARABICA PROD.	ROBUSTA PROD.	OTHER PROD.	TOTAL PROD.	YIELD KG/HA
OCTOBER	1960/61	625	480	565	75	640		3,134		3,134	392
	1961/62	630	500	580	80	660		1,608		1,608	193
	1962/63	635	516	590	80	670		3,140		3,140	365
	1963/64	650	560	605	75	680		4,275		4,275	458
	1964/65	665	587	620	70	690		3,342		3,342	342
	1965/66	685	615	635	75	710		4,343		4,343	424
	1966/67	710	632	645	85	730		2,010		2,010	191
	1967/68	730	649	660	90	750		4,712		4,712	436
	1968/69	765	665	675	90	765		3,328		3,328	300
	1969/70	868	752	720	90	810		4,414		4,414	352
	1970/71	887	774	725	100	825		3,996		3,996	310
	1971/72	910	795	750	115	865		4,544		4,544	343
	1972/73	953	841	800	130	930		4,007		4,007	286
	1973/74	1,060	850	860	150	1,010		4,368		4,368	308
	1974/75	1,108	860	950	175	1,125		4,486		4,486	313
	1975/76	1,214	901	975	275	1,250		5,266		5,266	351
	1976/77	1,254	921	1,000	300	1,300		4,867		4,867	317
	1977/78	1,269	950	1,050	270	1,320		3,123		3,123	197
	1978/79	1,240	1,090	1,120	190	1,310		4,742		4,742	261
	1979/80	1,250	1,105	1,173	152	1,325		3,973		3,973	216
	1980/81	1,260	1,225	1,202	134	1,336		6,090		6,090	298
	1981/82	1,187	1,100	1,243	102	1,345		4,160		4,160	227
	1982/83	1,290	1,155	1,214	146	1,360		4,510		4,510	234
	1983/84	1,300	1,105	1,202	212	1,414		1,420		1,420	77
	1984/85	1,260	1,122	1,257	154	1,411		4,609		4,609	246
	1985/86	1,290	1,146	1,318	166	1,484		4,420		4,420	231
	1986/87	1,320	1,160	1,392	213	1,605		4,000		4,000	207
	1987/88	1,340	1,170	1,463	212	1,675		4,500		4,500	231

Source: USDA

TABLE 4.2. INITIAL AND FINAL ANNUAL EXPORT ICO QUOTAS OF CÔTE D'IVOIRE

Year	Initial Annual Quota (60 kilo bags)	Final Annual Quota (60 kilo bags)
1980/81	3,521,222	3,017,184
1981/82	4,147,609	4,147,602
1982/83	4,015,697	3,786,516
1983/84	4,031,519	4,220,908
1984/85	4,362,816	4,152,410
1985/86	4,128,192	4,512,192

Source: ICO Statistics on Coffee

percent of total exports. Stocks have also always been in existence and were evaluated at 1.2 million bags in 1986 (Table 4.3.).

Less than 5 percent of the coffee produced by Côte d'Ivoire is consumed locally. Therefore, almost the total production is exported to generate the revenues that the country is in need of for development purposes.

4.2. Exports and Revenues

At the time of the country's political independence in 1960, coffee exports represented 50 percent of Côte d'Ivoire's total exports (USDA). In 1979, the Central Bank of the States of West Africa estimated that the two main Côte d'Ivoire export commodities, coffee and cocoa, accounted for 63 percent of the country's earnings, with 32.4 percent coming from coffee exports alone. Today, coffee still remains important for the Ivorian economy, accounting for 25 percent of total exports.

The revenues generated by coffee sales remain, however, as variable as the fluctuations in either export prices or the exportable volume. In general, the increase in export revenues has been linked more to an increase in the volumes exported than to an increase in international coffee prices. Real prices fluctuated significantly with a standard deviation of 50.35 from the mean from 1961 to 1983 (data

TABLE 4.3. Cote d'Ivoire:

COFFEE SUPPLY & DISTRIBUTION 1960/61-1987/88
(IN THOUSANDS OF 60 KILOGRAM BAGS)

CROP YEAR	BEGINNING STOCKS	PRO-OUCTION	IMPORTS	TOTAL S/O	DOMESTIC USE	BEAN EXPORTS	RSTD/GRNO EXPORTS	SOLUBLE EXPORTS	TOTAL EXPORTS	ENDING STOCKS
1960/61	847	3,134	2	3,983	2	2,632	0	0	2,632	1,349
1961/62	1,349	1,608	2	2,959	150	2,657	1	0	2,658	151
1962/63	151	3,140	0	3,291	6	2,609	2	10	2,621	664
1963/64	664	4,275	0	4,939	6	3,555	2	12	3,569	1,364
1964/65	1,364	3,342	0	4,706	9	2,670	4	14	2,688	2,009
1965/66	2,009	4,343	0	6,352	884	2,911	6	24	2,941	2,527
1966/67	2,527	2,010	0	4,537	1,550	2,743	7	30	2,780	207
1967/68	207	4,712	0	4,919	12	3,280	6	29	3,315	1,592
1968/69	1,592	3,328	0	4,920	1,270	2,875	10	50	2,935	715
1969/70	715	4,414	0	5,129	401	3,068	9	54	3,131	1,597
1970/71	1,597	3,996	0	5,593	538	3,297	7	64	3,368	1,687
1971/72	1,687	4,544	0	6,231	24	3,736	8	54	3,798	2,409
1972/73	2,409	4,007	0	6,416	41	3,537	9	63	3,609	2,766
1973/74	2,766	4,368	0	7,134	1,180	4,375	7	84	4,466	1,488
1974/75	1,488	4,486	0	5,974	848	3,463	3	93	3,559	1,567
1975/76	1,567	5,266	0	6,833	159	5,447	4	88	5,539	1,135
1976/77	1,135	4,867	0	6,002	85	4,520	6	81	4,607	1,310
1977/78	1,310	3,123	0	4,433	36	3,739	5	75	3,819	578
1978/79	578	4,742	0	5,320	18	4,580	5	75	4,660	642
1979/80	642	3,973	0	4,615	19	3,196	5	75	3,276	1,320
1980/81	1,320	6,090	0	7,410	20	3,614	5	75	3,694	3,696
1981/82	3,696	4,160	0	7,856	21	4,707	4	216	4,927	2,908
1982/83	2,908	4,510	0	7,418	23	3,940	5	258	4,203	3,192
1983/84	3,192	1,420	0	4,612	25	4,046	4	213	4,263	324
1984/85	324	4,609	0	4,933	27	3,603	4	249	3,856	1,050
1985/86	1,050	4,420	0	5,470	29	4,051	4	233	4,288	1,153
1986/87	1,153	4,000	0	5,153	30	3,700	4	220	3,924	1,199
1987/88	1,199	4,500	0	5,699	30	4,120	4	240	4,364	1,305

August 1987

Source: Horticultural & Tropical Products Division, FAS, USDA

Table 4.4.) with a coefficient of variation of 43.46 percent for the twenty-three years, pointing out the great fluctuations in the prices over the years (Figure 4.1.). Exports and real revenues have been, on the other hand, found to be highly correlated at +.76 (Figure 4.2.).

Côte d'Ivoire sells its coffee mainly in green beans to developed countries who are members of ICO. Her major trading partners are France, the United States, Italy, and the Netherlands. The demand elasticity remains very low at -0.29 (calculated from FAO data). The domestic coffee marketing system in Côte d'Ivoire is fairly well developed as the country exports about 95 percent of its production.

4.3. Marketing of Coffee in Côte d'Ivoire

4.3.1. Coffee Preparation for the Market

Coffee is originally bought directly from the small grower or from a cooperative of which the small producer is a member. The commodity is purchased by a local merchant on behalf of a local exporter at the guaranteed producer price.

After the coffee has been dried, ripened, cleaned, and sorted either manually by the farmer or electronically in the newly installed plants, it is transported to Abidjan, the main port. The Ivorian coffee travels mainly in trucks and a small percentage is carried by train from the producing

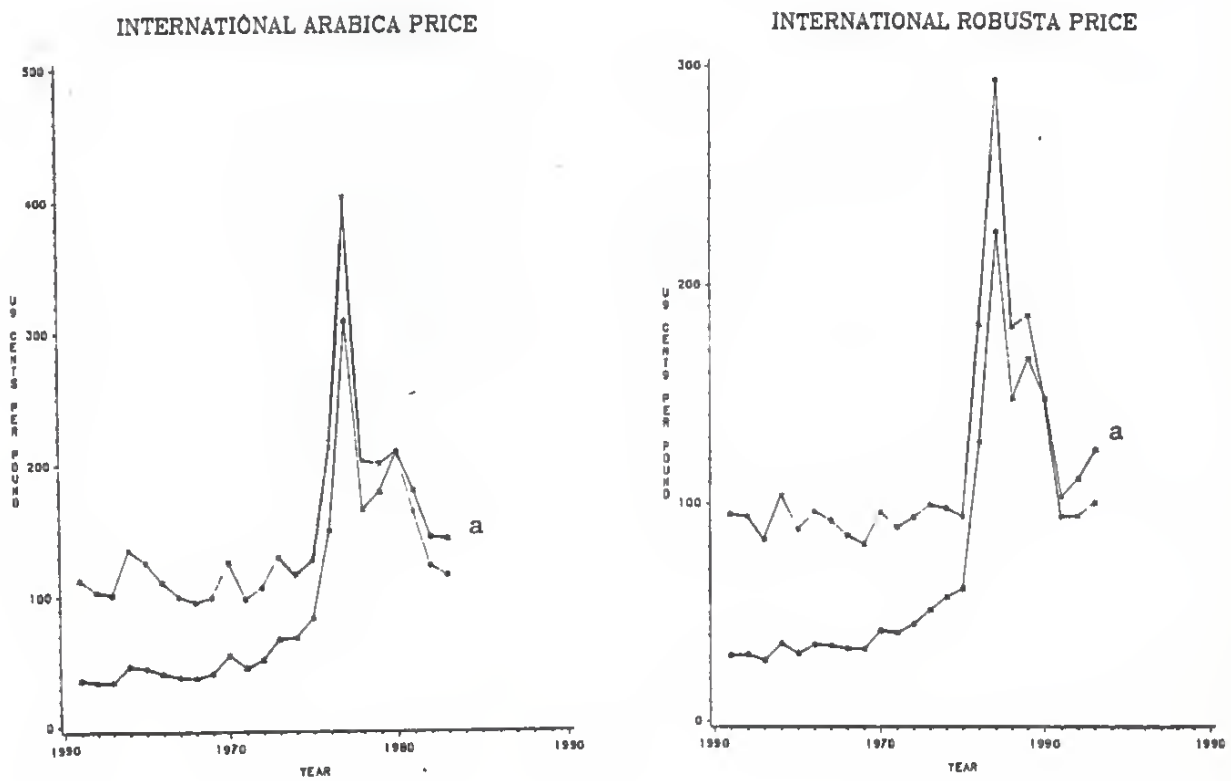
TABLE 4.4. Côte D'IVOIRE COFFEE: PRICES, VOLUME EXPORTED AND EXPORT EXPORT EARNINGS.

YEAR	PIR	PIA	VE	INDEX[a]	CPIR[b]	CPIA[b]	EE	CEE[b]
1961	30.5	36.0	2.6	32.1	95.0	112.1	0.8	2.5
1962	30.9	34.0	2.7	32.9	93.9	103.3	0.8	2.5
1963	28.2	34.1	2.6	33.8	83.4	100.9	0.7	2.2
1964	35.9	46.7	3.6	34.6	103.8	135.0	1.3	3.7
1965	31.4	44.7	2.7	35.6	88.2	125.6	0.8	2.4
1966	35.5	40.8	2.9	36.9	96.2	110.6	1.0	2.8
1967	35.0	37.8	2.7	38.0	92.1	99.5	0.9	2.5
1968	33.6	37.4	3.3	39.4	85.3	94.9	1.1	2.8
1969	33.6	40.8	2.9	41.3	81.4	98.8	0.9	2.4
1970	41.8	54.6	3.1	43.6	95.9	125.2	1.3	3.0
1971	40.8	44.8	3.3	45.9	88.9	97.6	1.3	2.9
1972	44.9	51.0	3.7	48.0	93.5	106.2	1.7	3.5
1973	51.3	66.9	3.5	51.7	99.2	129.4	1.8	3.5
1974	57.2	68.1	4.4	58.6	97.6	116.2	2.5	4.3
1975	61.1	82.8	3.5	65.1	93.9	127.2	2.1	3.3
1976	127.9	149.8	5.4	70.5	181.4	212.5	6.9	9.8
1977	224.3	308.6	4.5	76.4	293.6	403.9	10.1	13.2
1978	147.8	165.6	3.7	81.9	180.5	202.2	5.5	6.7
1979	165.9	178.9	4.6	89.4	185.6	200.1	7.6	8.5
1980	147.5	209.4	3.2	100.0	147.5	209.4	4.7	4.7
1981	103.2	180.0	3.6	109.9	93.9	163.8	3.7	3.4
1982	111.2	144.8	4.7	118.1	94.2	122.6	5.2	4.4
1983	124.3	143.3	3.9	124.1	100.2	115.5	4.8	3.9

Source: FAO and USDA

PIR = International Robusta Price in U.S. cents per pound
PIA = International Arabica Price in U.S. cents per pound
VE = Volume Exported in million of 60 kg. bags
EE = Export Earnings in million U.S. dollars
a = IMF Index of Consumer Price in Industrial Countries, 1980=100
b = Constant Terms

FIGURE 4.1. COFFEE; INTERNATIONAL PRICES.

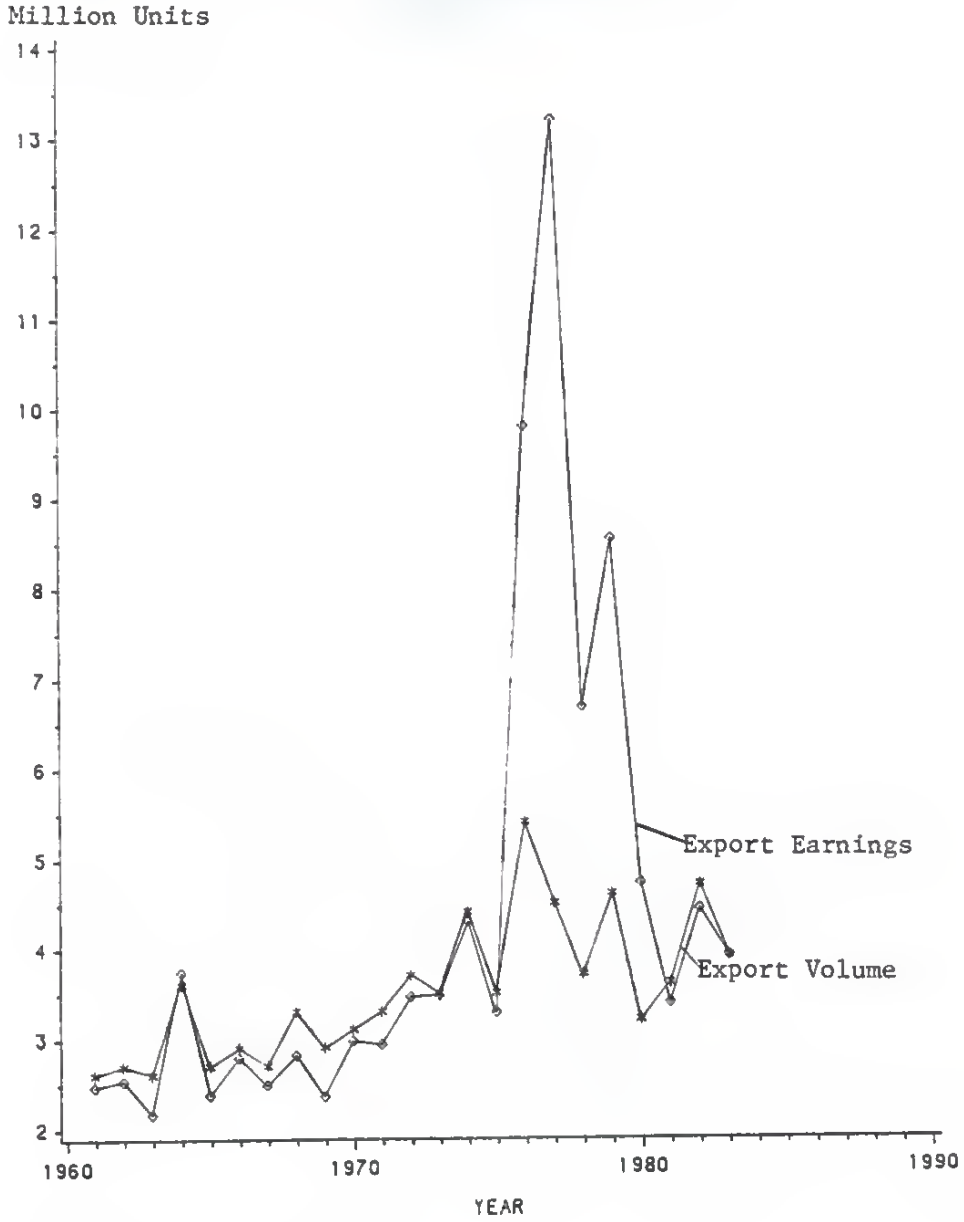


[a]= Deflated Prices by the IMF Index, 1980=100.

Source: FAO Trade Yearbooks, Various Issues.

COTE d'IVOIRE COFFEE:

FIGURE 4.2. EXPORTS VS. EARNINGS



Sources: FAO and USDA

regions to the exporters' warehouses. Once in the warehouse, the coffee is further treated for either export, local usage, or stock holding.

For export purposes, the coffee is classified in four grades according to the size of the bean: Grade I (highest) is screen 16, Grade II is screen 14, III is screen 12, and IV is screen 10.

On the international market, the Ivorian coffee popularity is in part due to the supply being in large parcels of uniform quality: 96-97 percent of the coffee is grade III.

All the domestic coffee preparation is supervised by a governmental agency: CSSPPA (Caisse de Stabilization et de Soutien des Prix des Produits Agricoles) or Stabilization Fund.

4.3.2. The Role of the Stabilization Fund

CSSPPA or Stabilization Fund in short, is the official marketing agent of the Ivorian coffee. It is a parastatal organization which stabilizes prices on the domestic level of coffee, cocoa, cotton, and banana. It guarantees a minimum fixed price to the producer each year and a CIF (cost, insurance, and freight) price is guaranteed to the licensed coffee exporter.

Unlike marketing boards in some other countries, the Ivorian Stabilization Fund does not get in possession of the product. It acts as a supervisor of the marketing operation and issues licenses to exporters. In order to be a legal exporter, a firm or person must obtain a license from the Fund. Each exporter is assigned about 2 percent of the country's total coffee exports. That quota is revised every year. The exporter may be solely responsible for all the conditioning and coffee transportation costs up to the shipping port. If his expenses after all happen to be higher than the guaranteed export (CIF) price, the exporter will be refunded by the Stabilization Fund. If the opposite case occurs (guaranteed price higher), the exporter makes up the difference to the Fund. More and more these days, the Fund is involved actively in the sale of especially large coffee quantities to the biggest buyers. In that case, the exporter is just an intermediary between the Fund and the buyer, following the conditions determined by the Fund.

During good coffee years with high international coffee prices, the stabilization fund generates a surplus which is expected to help make up the gap left by bad coffee years (lower international prices) in the economy. For many years, the fund surplus came from taxing the farmer by fixing a minimum price lower than the world price. Although the coffee grower in Côte d'Ivoire saw the guaranteed price rise

every year, it was still very much lower than the world price applied to the fund.

Table 4.5. shows some order of difference between the international and domestic Robusta prices. The difference between the fixed producer price (2) and the unit value of Côte d'Ivoire exports (3) is a positive gain for the Ivorian Stabilization Fund. The revenues generated are supposed to be used to stabilize the farmer's income when world coffee prices are very low. However, the fund has been using its revenues in other sectors of the economy more often than in agriculture.

TABLE 4.5. ORIGINS OF THE IVORIAN FUND SURPLUS

Year	Côte d'Ivoire grower price				Unit value of exports (Fob) (3)		Surplus
	FCFA/kg (1) Local currency		Equivalent U.S. ¢/lb (2)				
	Current	Const.*	Current	Const.*	Current	Const.*	(3)-(2)
1981	300	283	48.07	51.13	103.43	110.03	+58.90
1982	300	250	41.37	44.97	85.28	91.70	+46.73
1983	300	240	35.51	40.35	99.06	111.30	+70.95
1984	350	265	36.33	42.24	118.53	134.49	+92.25
1985	380	290	36.91	42.92	120.35	143.49	+100.35
1986	400	286	50.90	55.93	143.01	140.20	+84.28

Sources: ICO statistics

* Current terms deflated by the U.N. Index of unit value of exports of manufactured goods from developed market economies (Appendix D).

Chapter 5

Futures Markets and Coffee

5.1. General Definition of Futures Market

A futures market is an organized pricing institution. A well developed futures market approximates closely the economic concepts of a perfectly competitive market; there are many buyers and sellers dealing in a standardized commodity (the futures contract). Traders do not have perfect knowledge, but in principle, they have equal access to available information. In fact, prices and price changes are public knowledge (Tomek 1981).

5.1.1. The Futures Contract

A futures contract is a legal contract, enforceable by the rules of the exchange through a clearinghouse, to deliver or accept delivery of a definite amount of a commodity during a specified month at a specified price. The contract specifies volume, quality, time of delivery, delivery point, and price. All contracts for a particular commodity on a given exchange are identical, but contract specifications may differ from market to market.

Sale of a futures contract is an obligation to make delivery to the buyer (quantity, quality, time, and place as specified by the contract) at the price at which the contract was sold.

Purchase of a futures contract is an obligation either to accept delivery of the quantity and quality of product specified in the contract or to take an offsetting position in the futures market by selling an identical contract. The right to buy and sell in the specific market goes only to members of the exchange. Non-member traders place orders through a professional broker, who is a member, at established commission prices. Trade occurs in one physical place, the floor of the exchange, during the trading session. The traders cry out bids and offers, making a bilateral auction market. A principal economic justification of the futures market remains its price risk reducing function through hedging.

5.1.2. Hedging

Hedging, put simply, is establishing a position in futures opposite from the one held in the spot (cash) market. A selling hedge involves the sale of futures contracts. A buying hedge refers to the purchase of futures contracts. A short hedge exists when a producer, trying to reduce price risk during the production or storage of a commodity, sells

an equivalent quantity of the commodity in the futures market. The producer is "short" as he sells contracts not covered by purchases. He is obliged to make delivery at the agreed-upon time at the specified price.

A long hedge refers to the producer or processor who sets the commodity purchase price in advance by buying futures contracts. The producer is "long" on futures as he purchases contracts not covered by sales and is therefore obliged to accept delivery and pay for the contracted amount at the specified time. Hedging is possible because of the relationship that exists between futures prices and cash prices for the commodity traded. The differential between the futures and the cash price of the commodity is called the basis. The basis ordinarily narrows as the delivery month is approached, and it approaches zero at the delivery point at the maturity of the contract.

In a perfect hedge, the loss in the cash market is exactly offset by the gain in the futures market. For example: Assume, an exporter of coffee (e.g. Côte d'Ivoire Stabilization Fund) buys 375,000 pounds (ten contracts) of coffee from growers. The Fund would use the futures market and sell equivalent futures to protect the value of its purchases from producers and would buy futures to cover its forward sales to coffee roasters. The exporter may face any of the three following cases:

Date	Cash	Futures	Basis
CASE 1: A cash price rise			
Jan. 3	Buys 375,000 lbs. worth $2.12/lb. Total $795,000	Sells 375,000 lbs. March @ $2.14/lb. Total $802,500	2¢ under
Feb. 1	Sells 375,000 lbs. @ $2.25/lb. Total $843,750	Buys 375,000 lbs. March $2.26 Total $847,500	1¢ under
Gross gain/loss	+ $.13/lb. + $48,750	- $.12/lb. - $45,000	Net gain = $3,750 or $.01/lb.
CASE 2: An exact offset hedge			
Jan. 3	Buys 375,000 lbs. $2.12/lb.	Sells 10 March futures $2.14	2¢ under
Feb. 1	Sells 375,000 lbs. $2.02	Buys 10 March futures $2.04	2¢ under
Gain/loss	- $.10/lb.	+ $.10/lb.	Net gain $0
CASE 3: Cash price falls			
Jan. 3	Buys 375,000 lbs. $2.12/lb.	Sells 10 March futures $2.14	2¢ under
Feb. 1	Sells 375,000 lbs. $1.88/lb.	Buys 10 March futures $1.89	1¢ under
Gain/loss	- $.24/lb.	+ $.25/lb.	Net gain $.01/lb.

5.1.2.1. Basis Behavior

In practice, the basis will depend on several factors. These include:

1. Location relative to the delivery point for the futures contract.
2. Quality difference between the cash item and the futures contract specifications, and
3. Storage costs (eventually) that are incurred in the time period involved before contract maturity.

Fluctuations in the basis are almost invariably "much less" than fluctuations in commodity prices, explaining the risk reducing role attributed to a hedge. However, the possibility of adverse price movements for either long or short futures positions exists and that is why traders are required to make a margin deposit of a small percentage (5-10 percent) of the total value of the contracts. "Margin calls," i.e. when the trader is asked to provide additional funds when the margin goes below the "maintenance level," occur when adverse price movements exist on the market (price decline for the purchaser and price increase for the seller). Hedging permits a reduction of price risks taken by producers and firms by shifting part of the risk to speculators.

5.1.2.2. The Speculator in Futures Markets

Speculators are motivated by profit. They assume the hedger's risks by taking the opposite side of a contract, i.e. they agree to either make or take delivery from the hedger at a later date at a specified price. Speculators do not take offsetting positions in the cash market. A speculator profits if he can buy a contract for less than he sold it for or if he can sell for more than he paid. Trading by speculators provides market liquidity necessary for the exchange to function well. Speculators are assumed to be relatively less risk-averse than hedgers. They play a vital role in the futures market.

5.2. Organization of Coffee Futures Trading

Coffee futures trading is conducted on two commodity exchanges: the New York Sugar and Coffee Exchange, and the London Terminal Exchange. The two markets trade different varieties of coffee and have their own different contract specifications.

5.2.1. The New York Coffee, Sugar, and Cocoa Exchange (CSCE)

The New York Coffee Exchange is the futures market for Arabica. Trading on the coffee exchange started in 1949

with the "S" contract, which underwent minor changes to become the "B" contract in 1956. In 1958, the "M" contract, based on coffee from Colombia, was born. From 1949 to 1972, coffee contracts on the New York Coffee Exchange were largely oriented toward Brazil with Santos coffee (the basic Brazilian grade) serving as a reference in pricing. Starting August 24, 1972, the "M" contract was replaced by the "C" contract. The new contract, still in use, is based on coffee from Guatemala, Mexico, and El Salvador (i.e., washed Arabica coffee) with MAMS (Colombian coffees from Manizales, Armenia, and Medellin) and other Colombian growths deliverable at a premium. Coffee from eleven[1] additional countries was later allowed delivery on the "C" contract which still does not accept Robusta coffee.

A grading system on the exchange differentiates between discounts for growths below the norm and premium for growth of better quality, whereas the basis represents the norm. The differentials are set by the Board of Managers of the exchange's Coffee Committee based on market conditions and are reviewed often.

Certification applies to the coffee that is submitted for delivery on the "C" contract and is based on the quality of the coffee beans and limited to the number of imperfections (maximum twenty-three). Similarly, coffee bean

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[1]The 11 countries are: Kenya, Tanzania, Uganda, New Guinea, Peru, Venezuela, Dominican Republic, Burundi, Ecuador, India, and Rwanda.

size is subject to regulation and the contract stipulates that:

1. "50 percent of coffee sampled must screen 15 or larger.
2. No more than 5 percent of coffee sampled may screen below 14."

Another requirement of the contract is that coffee should be in "sound" condition, i.e. not damaged by improper storage, shipping, or handling. The standardized contract size on the New York Exchange for coffee is 37,500 pounds or 250 bags. One bag equals 60 kg (132.28 pounds) of coffee, delivered ex-warehouse.

Only members of the New York Coffee, Sugar, and Cocoa Exchange are allowed to do business on the exchange. A membership is often called a seat on the exchange and non-members conduct their business through a member who is a broker. A member may also sell his seat to a non-member according to certain rules. The CFTC (Commodity Futures Trading Commission) is the federal agency which has been regulating the commodity futures industry since 1975. In 1977, the CFTC proposed some regulations related to foreign traders which would 1. reveal the foreign trader position and identity; and 2. restrict to a limit foreign access to U.S. markets.

The proposition received wide criticism and opposition by the New York Exchange authorities, who felt the measures were unfair to foreign traders and could limit their

future participation in the market. They were, nevertheless, eventually adopted and

> effective in May 1979, foreign brokers were specifically required to identify and report on individual traders who held reportable positions through them....Effective in January 1980, foreign brokers, customers of foreign brokers, and foreign traders were required to designate and agent in the U.S. to receive communications from the CFTC. (Kuhn et al. 1985).

These regulations by the CFTC, except the last one, have been found, however, by Kuhn et al. not to have affected the foreign participation in the coffee market that much.

5.2.2. The London Coffee Terminal Market

The Coffee Terminal is a part of the London Commodity Exchange (LCE) for cocoa, coffee, sugar, and rubber. It trades only Robusta coffee grown in Africa and Asia. The standardized contract size is 5 metric tons or approximately 11,023 pounds delivered on a stored-in-warehouse basis. The contract also specifies a standard quality or grade. There are sixteen varieties of Robusta coffee deliverable at the London Terminal and six grades, decided by visually classifying and counting defects or imperfections. The normal Uganda, Ivory Coast (Côte d'Ivoire), Cameroon, and such varieties will pass usually as grades 1 or 2. The price is based on grade 1. Samples sent in for grading must be 3 kg. each representing a specific and

identifiable lot of five tons. Any suspicion of taint or unclean smell will warrant rejection as "unsound" coffee.

The Bank of England is the financial regulator of the London Futures Markets in conjunction with the CTMA (Coffee Terminal Market Association) for the coffee futures market. The bank's role is only one of surveillance. Unlike the New York Exchange, the London Terminal does not have any written legislation that could prevent any market flexibility. Also, the London Market has no daily price fluctuation limit, whereas the New York market imposes a daily price limit. This latter feature of the London market seems to be very much favored by some traders, including Griffins (Coffee International, 1978) that do not see any benefit of the price limit procedure.

One innovation of the Coffee Exchanges (London and New York) is the possibility of dealing in options. An option confers the right, but not the obligation, to buy or to sell a futures contract at a specific price on or before a certain date in the future. On payment of a premium, a client can buy "call options" (the option to buy), "put options" (the option to sell), and "double options" (the option to buy or sell). The major attraction of options lies in the fact that risk potential is limited to the extent of the premium. If after buying a call options for future delivery, the market price collapses, for example, the option can be negated and all that would be lost would be the amount of the premium paid.

In recent years, options have been attracting considerable interest as shown by the figures; in 1976, 16,000 options contracts were registered compared to only sixteen options in 1971 on the London Exchange alone.

5.2.3. Limitations of the Coffee Futures Market

Both the New York and the London markets have some serious limitations in dealing with coffee futures. The New York futures market serves only as a hedge for washed and a limited amount of unwashed Arabica coffees but the Brazilian unwashed Arabica is not tenderable on the New York Exchange nor on the London Terminal. Also, in New York, Robusta coffee cannot be delivered on a futures contract. It is tenderable only on the London market where other coffees are not allowed delivery. For the coffee futures markets to fulfill their intended purpose, i.e. reduce price fluctuations and attract more traders, Zimmerman (1986) proposes to rewrite the existing coffee contracts for both New York and London and create a contract against which all coffees can be tendered. He suggests a same size contract of ten metric tons (medium between the two present contracts). That should make real arbitrage trading possible, argues the author. Other forthcoming results would also include the "reduction of squeezes" and a more even distribution of excess supplies between Europe and the U.S.

While market participants hope for these changes to make the coffee futures market a more efficient one, the present futures market is still better than no futures market at all so long as it offers coffee producers better ways to limit risk and ensure more stable export earnings.

Chapter 6

Optimal Hedging Strategy for a Coffee Producer

Recent literature has emphasized the potential for primary producers to use the commodity futures markets for risk management purposes and essentially to protect themselves from income variability. The first section will present the background literature dealing with the subject and in particular the determination of optimal hedging levels when a producer is faced with uncertainty in prices, production, and finance. The common assumption made is that the producer is risk averse.

6.1. Background Studies

McKinnon (1967)

In his article entitled "Futures Markets, Buffer Stocks, and Income Stability for Primary Producers," McKinnon took an early look at the potential utilization of futures markets for income stabilization by primary producers. His study was one of the first of its kind. Earlier hedging literature had concentrated rather on decision making of merchants holding inventories.

In McKinnon's study, the farmer or primary producer is assumed to be risk averse and has to deal with output and price uncertainties. He has to make a trade-off between risk

and expected output and therefore his objective is to minimize income variance. The author developed two models to prove his point.

In the first model, an optimal forward sale is derived as the only method of hedging available. Under the assumptions that the producer does not find it feasible to carry buffer stocks and that there are no hedging costs, McKinnon's optimal hedge ratio suggested that a farmer faced with variance in output as well as prices would hedge less than 100 percent of his expected output and "the greater output variability is relative to price variability the smaller will be the optimal forward sale."

McKinnon's second model referred to forward sales combined with individual buffer stocks over a longer period of time (two years). The model revealed that an optimum combination would minimize the variance of the farmer's disposable income. The buffer stock in this model took care of the output fluctuation present in model I.

The author concluded by restating his first view that direct spot price manipulation and international commodities agreements are inefficient ways of stabilizing producer's income because they are an "unnecessarily costly method of achieving government policy goals." McKinnon recommends that "the public authority" get rid of such costly programs and rather take a long term position on the futures market as the results of his models suggest.

Ward and Fletcher (1971)

The authors presented a general theoretical model for optimal firm decisions in cash and futures markets by considering both primary producers and marketing agencies. The model was applied to both short and long hedging and speculation under income, cost, and risk considerations. Assuming that the decision maker (a feedlot operator) wished to maximize expected net income, Ward and Fletcher arrived at the conclusion that an optimal hedging position in the futures market given the earliest assumptions may be one of the following:

1. less than one (less than 100 percent hedge)
2. equal to one (100 percent hedge)
3. greater than one (hedging and speculation), speculation being "when a firm's futures position exceeds the 100 percent hedging level or when it does not provide hedging possibilities in conjunction with the cash market position."

Anne Peck (1975)

In her attempt to derive the optimal hedging level for an egg producer, Peck used a portfolio-type analysis. She assumed that production was known; only price was uncertain and so was expected return. Thus, the author's results suggest optimal hedge of less than 100 percent of expected production (75 percent to 95 percent) for the egg producers for all the different risk parameters: $\infty \geq \lambda \geq 0.001$

Rolfo (1980)

In the case study of a cocoa producer faced with price and quantity uncertainty, Rolfo assumed that producers maximized expected utility of income within a mean-variance (E-V) framework as well as a Bernouillian utility function. Rolfo derived the optimal hedge ratio using the forecast errors on price and quantity obtained from his expectational values and found a hedging ratio less than one, implying that a full 100 percent hedge is not recommended for all three risk averse producers under study (Côte d'Ivoire, Ghana, and Brazil). However, when the risk parameter is lower than one, the author recommends a reverse hedging position.

Bond and Thompson (1985)

In their article "Risk Aversion and the Recommended Hedging Ratio," the authors assumed that an individual wants to maximize expected profit in the next time period adjusted to risk where risk is measured by the variance of profit from their objective function:

$\Omega = E(\Pi) - \lambda \, var(\Pi) \quad \lambda > 0$

Π = Profit

λ = Risk parameter

E = Expectation

Var = Variance

Bond and Thompson derived the optimal hedging ratio that is dependent on the individual risk parameter:

$$\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \frac{\mu_1\sigma_2^2 - \mu_2\sigma_{12}}{\mu_2\sigma_1^2 - \mu_1\sigma_{12}} + \frac{\mu_1 b}{\lambda(\mu_2\sigma_1^2 - \mu_1\sigma_{12})}$$

where:

μ_1 = the expected return per unit from holding a long futures position

μ_2 = the expected return per unit from holding a long cash position

x_1 = level of futures positions

x_2 = level of cash positions

σ_1^2 = variance of the profit from holding a futures position

σ_2^2 = variance of the profit from holding a cash position

σ_{12} = covariance between the profit from holding a futures position and the profit from holding a cash position

b = storage cost coefficient

The authors findings show that "whenever transaction costs associated with storage, financing, or other activities are nonlinearly related to the level of market participation, risk will be relevant in the determination of the recommended hedging ratio." In fact, as risk aversion increases, the individual hedges more or speculates less, relative to the cash market.

Alexander et al. (1986)

The authors presented an empirical analysis of optimal preharvest decisions in both the cash and futures markets incorporating price, production, and financial risks. Using a mean-variance framework on the assumption of a risk averse producer (corn and soybean producers in Georgia and Illinois), Alexander et al. reached the conclusion that

> A partial hedge is optimal for most situations for risk averse producers when the amount hedged is variable. With fixed quantity transactions, speculative and cash positions, but not hedging, tend to be E-V efficient.

On the other hand, the authors found that the exclusion of financial costs have limited, if any, effect on the variable futures positions. They think that is probably the reason why zero financial costs have been extensively assumed in the literature.

Miller Stephen (1986)

The author's objective was to test "whether the absence of basis risk with forward contracting explains apparent producer preference for forward contracting vis-á-vis direct hedging as a forward pricing tool." The analysis was done by following a mean-variance model á la Rolfo with modifications to "accommodate forward contracting (which is not subject to basis risk) as an alternative to direct hedging (which is subject to that risk)." The study was applied to soybean producers for ten South Carolina counties from 1975 to 1984. The empirical results indicated that

the absence of basis risk with forward contracting does not explain producer preference for forward contracting over direct hedging as a forward pricing tool. Infinitely risk averse producers would have incentive to forward contract or hedge quantities smaller (larger) than their expected output if yields and harvest time prices are negatively (positively) correlated.

It can be seen from the past literature dealing with producer hedging that when the primary producer is faced with risks, partial hedging may be optimal (i.e. less than 100 percent hedging). The studies also showed that hedging and speculation are not two incompatible behaviors. In fact, all will depend on the association between price and output on the cash market; a negative price-output correlation will mean greater hedging incentives for the producer while a positive correlation may encourage the farmer to combine hedging and speculation, i.e. hedge more than 100 percent of his expected output on the futures market.

6.2. Theoretical Framework

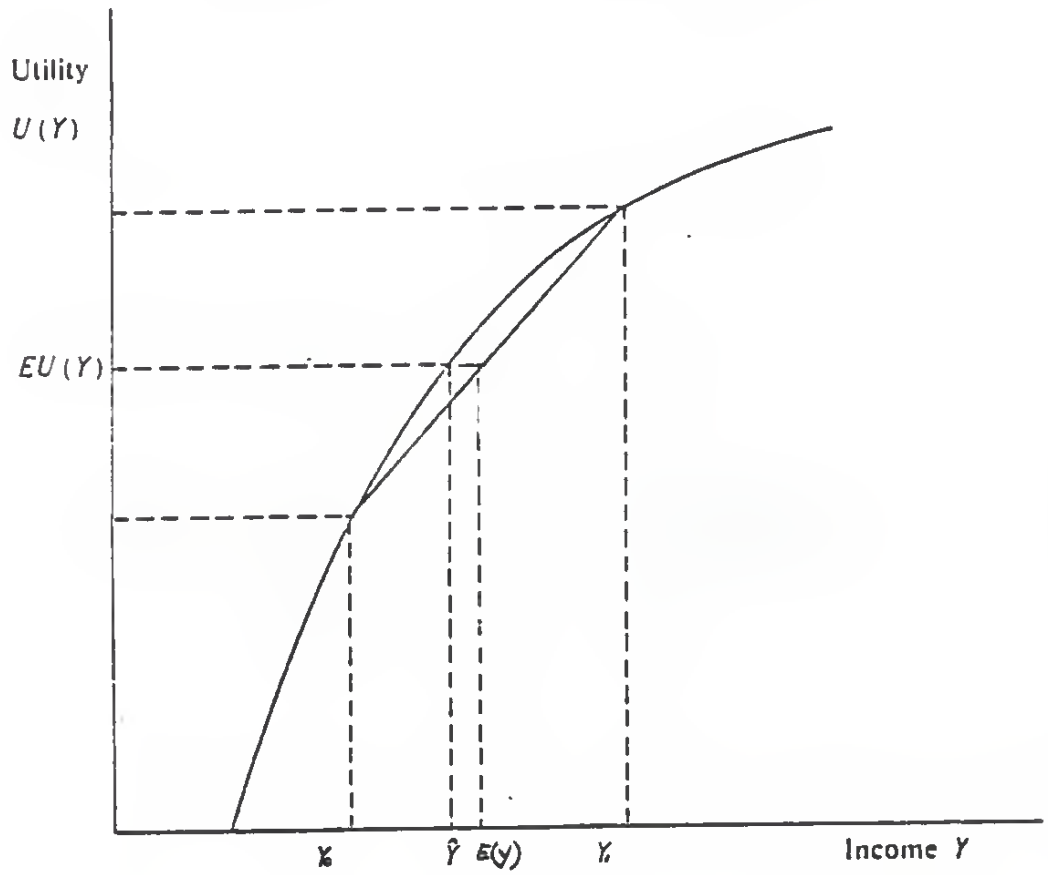
Assuming that an important goal of the agricultural commodity producer is income stabilization, the assumption that the producer is risk averse becomes an implicit one. The theoretical foundation of this proposition is that the producer maximizes expected utility. In the face of risk, the producer will choose the action which maximizes the expected value of the utility of the outcome, i.e. his income. The individual maximizes EU(Y).

Y = risky outcome = income

EU = expected utility

The utility function U(y) for a risk-averse individual is shown on the figure below:

FIGURE 6.1. THE VALUE OF RISKY OUTCOME



$\hat{y}$ = certainty equivalent income

$$E(y) = \begin{cases} y_0 \text{ with probability } P \\ y_1 \text{ with probability } (1-P) \end{cases}$$

The expected utility is given by:

$$EU(y) = P\,[U(y_0)] + (1-P)\,[U(y_1)]$$

A certainty equivalent (CE) is the amount exchanged with certainty that makes the decision maker indifferent between this exchange and some particularly risky prospect.

The difference between the expected value of income (i.e. the mathematical expectation) and the certainty equivalent income $(E(y) - \hat{y})$ is the risk premium i.e. the amount the individual would pay to avoid a risky situation. For a risk averse individual, $CE < E(Y)$.

e.g. Assume a person is indifferent to a risky prospect of P=0.4 of gaining \$10,000 and P=0.6 of losing \$2,000 and a sure prospect of gaining \$1,560. His certainty equivalent is CE = \$1,560.

If P = 0.5, EU = P [U(\$10)] + (1-P) [U(\$1000)].

A special class of utility functions has been found to be very useful and practical in dealing with the risk-averse individual and in solving portfolio problems such as the choice of hedge in a futures market. That special class is the exponential utility function.

6.2.1. The Exponential Utility Function

The exponential utility function is described in the form:

$$U(y) = 1-e^{-\lambda y}$$

U = Utility

y = Income

e = Exponential

λ = constant

This negative exponential utility function has an associated constant absolute risk aversion coefficient equal to:

$$\frac{-U''}{U'} = \lambda$$

where $\lambda > 0$

U' = first derivative of U with respect to y

U" = second derivative

One limitation of the exponential utility function is that the outcomes y are assumed normally distributed and therefore the absolute risk premium is independent of the level of wealth. Otherwise the exponential utility function has several attractive features:

1. It has linear asset demand functions with respect to wealth.
2. It allows expected utility to be expressed in terms of the mean and variance of income alone.

6.2.2. The Mean-Variance Framework

The mean-variance (E-V) model assumes that attitudes toward risk are described just in terms of the mean and variance of income. These characteristics are simple to estimate and manipulate although they are very restrictive. From Markowitz (1959) models of portfolio selection, "a portfolio is E-V efficient if it maximizes expected rate of return (E) for a given variance (V) and minimizes the variance for a given expected return."

The E-V Framework assumes four sufficient conditions:

1. The producer's utility function is quadratic.
2. Net incomes are normally distributed.
3. The producer's choices involve a single random variable.
4. The producer's choices involve a linear combination of the random variable.

All sufficient conditions have been criticized as being restrictive but their application remains very convenient for computational purposes. That is what justifies the wide use of the E-V model for buffer stock and hedging problems (Rolfo, Alexander et al., Miller).

6.3. The Empirical Model

The purpose of this empirical analysis is to derive the optimal hedging level of a risk-averse coffee producer facing both quantity and price uncertainties. The data is applied to Côte d'Ivoire which is the third largest coffee producer with 6 percent of world production and an African developing country as well. The Ivorian coffee is ordinarily sold to the world market through a stabilization fund which is in some respects similar to a marketing board in some other countries.

In the following, a risk-averse coffee producer (Côte d'Ivoire) maximizes expected utility of income by the optimal choice of hedging level in the face of price and production uncertainties within a mean-variance framework. The producer's objective function is thus:

$$\Omega = EU = E(y) - \lambda \, Var(y) \qquad (1)$$

$$\lambda = \text{risk parameter} > 0$$

$$\text{Max } U(y) \equiv \text{Max } \Omega = \text{Max } E(y) - \lambda \, Var(y)$$

under the condition that y is normally distributed:

$$y \sim N[E(y) \, , \, Var(y)]$$

Assume that basis risk exists, i.e. the difference between the price on the physical market (P) and the futures market (PF) price at delivery is stochastic. Before the harvest, a future price (PP), assumed given and therefore constant, is quoted that is a predictor of the later realized future price (PF).

If Q is the producer output distribution, his income for selling on the cash market will be

$$y = P.Q.$$

By holding futures contracts n, the producer can modify his income to be:

$$R = y + n(PP - PF)$$

Output and price at harvest can be viewed at planting as random variables. The futures price at harvest is assumed to be stochastic at planting.

With hedging, the producer's objective function (1) becomes:

$$\Omega = EU = E(R) - \lambda \, Var(R)$$

$$\Omega = EU = E(y) + n(PP - E(PF) - \lambda \, [Var(y) + n^2 Var(PF) - 2nCov(y, PF)] \qquad (2)$$

Determination of the optimal size of futures contracts, n* results from maximization of expected utility in equation (2) with respect to n, the size of the futures contract.

The first order condition[1] identifying the optimal size futures contract, n* is:

$$\frac{\partial \Omega}{\partial n} = 0$$

$$\frac{\partial \Omega}{\partial n} = PP - E(PF) - \lambda \, [2nVar(PF) - 2Cov(y,PF)] = 0$$

---

[1]The second order condition assures a maximum; i.e.

$$\frac{\partial^2 \Omega}{\partial n^2} = -2 \lambda \, Var(PF) < 0$$

$0 < \lambda < \infty$ assuming risk aversion

$$n^* = \frac{Cov(y,\ PF)}{Var(PF)} + \frac{PP - E(PF)}{2\lambda\ Var(PF)} \qquad (3)$$

The optimal hedge n* of equation (3) is comprised of hedging and speculative components.

1. The first term: $\frac{Cov(y,\ PF)}{Var(PF)}$ is the hedging component and indicates the level of futures holdings which minimizes the variance of returns. It is the coefficient of PF in a linear regression where PF is the independent variable and y (i.e. the producer's nominal revenue generated by selling his output Q on the cash market), is the dependent variable.

2. The second term: $\frac{PP - E(PF)}{2\lambda\ Var(PF)}$ is the speculative component. E(PF) is expected price of futures at end of hedge. Var(PF) is the variance of futures price from a futures market transaction. The speculative component reflects the effects of hedging on the level of returns. It is inversely related to the producer's risk parameter and disappears if the producer is infinitely risk averse ($\lambda \rightarrow \infty$); or if the current futures price is an unbiased estimate of the future price at the time the hedge is lifted., i.e.

PP = E(PF) at delivery, assuming basis = 0.

Following Rolfo's approach and given that the pattern of coffee production changes with time given the age of the trees and technological progress, and not taking in account any basis risk, expectational data rather than historic data will preferably be used to measure price and

production uncertainty. Dividing the price by PP (price forecast) allows for different historical rates of inflation. Cash price forecast error (e_p) is given by:

$$e_p = [P - PP]/PP$$

Futures price forecast error, e_f, is given by:

$$e_f = [PF - PP]/PP$$

Production forecast error, e_q, is given by:

$$e_q = [Q - QF]/QF$$

where QF is forecast production.

Revenue forecast error, e_y, from cash marketing is thus:

$$e_y = e_p + e_q + e_p.e_q$$

Also:
$$P = PP\ (1 + e_p)$$

$$PF = PP\ (1 + e_f)$$

$$Q = QF\ (1 + e_q)$$

Optimal hedging level expressed as proportions of forecast production becomes:

$$\frac{n^*}{QF} = \frac{Cov\ [(1 + e_p)\ (1 + e_q), e_f]}{Var(e_f)} - \frac{E(e_f)}{2\lambda\ PP.QF.Var(e_f)}$$

(See Appendix E for derivation.)

6.4. Data

The coffee harvest time in Côte d'Ivoire is from November to April. Historical and expectational data used to derive later the forecast errors are collected for fourteen seasons, from 1973/74 to 1986/87 under the coffee "C"

contract on the New York Sugar, Coffee, and Cocoa Exchange. Two price series were obtained from various issues of The Wall Street Journal.

(1) The May closing futures prices reported on the last day of October = futures price predictor (PP).

(2) The May closing futures prices reported on the first active trading day of May = futures prices at delivery (PF). May was chosen as futures delivery month because it was the closest to the Ivorian harvest month (April) for futures to be delivered on the New York Exchange.

A third price series = the spot May prices on the cash market were obtained from Gordon and Paton via USDA, for Robusta coffee, the variety produced by Côte d'Ivoire.

Robusta futures prices could not be readily obtained from the London Coffee Exchange. Therefore, the Arabica coffee futures prices quoted on the New York Coffee Exchange and obtained from The Wall Street Journal will be used as a proxy for the unavailable Robusta futures prices. Thus, it is to be expected that the futures price (Arabica) and the spot price (Robusta) not be equal at delivery: this will imply a positive quality basis, because Arabica is always higher priced than Robusta, based on coffee quality.

The forecast output (QF) was obtained from the USDA estimates covering the fourteen seasons (1973-74 to 1986-87) and approximates very closely the realized output (Q) published by the ICO.

6.5. Empirical Results

The variables used in the analysis within the mean-variance framework are presented in Table 6.1.

Table 6.2 shows the mean values, standard deviation, and standard errors of mean of the forecast errors used in the model, along with other statistics. We can note that the mean of futures forecast error (e_f) is positive and significantly different from zero. The positive mean (e_f) implies that the ratio of optimal hedge (n*/QF) is an increasing function of the risk parameter in equation (3). The mean for forecast errors in cash prices (e_p) and quantity (e_q) are both negative, although close to zero. The variance of forecast errors for cash prices exceeds that of futures prices, on the other hand:

$$Var(e_p) = (0.072) > Var(e_f) = (0.071).$$

The covariance and correlation matrices among the forecasting errors are presented in Table 6.3. The correlation between the forecast error in revenues (e_y) and the forecast error in the cash market (e_p) is positive (0.80) and greater than the correlation between forecast error in revenue and forecast error in production (0.79);

$$R_{e_y.e_p} = (0.80) > R_{e_y.e_q} = (0.79)$$

Similarly $Cov(e_y.e_p) > Cov(e_y.e_q)$

$$(0.10) > (0.01)$$

The covariance between production and price forecast errors

TABLE 6.1.

Coffee Prices, Quantities, and Forecast Errors

	Futures Price Before Harvest	Futures Price At Harvest	Cash Market Price	Expected Production	Realized Production	Forecast Error on			
	(cents/lb.)			million bags		Futures Prices	Cash Prices	Production	Revenues
Season	PP	PF	PC	QF	Q	e_f	e_p	e_q	e_y
1973/74	68.67	70.90	63.68	4.0	4.4	0.03247	-0.07267	0.10000	0.02007
1974/75	57.10	48.30	47.73	5.0	4.5	-0.15412	-0.16410	-0.10000	-0.24769
1975/76	80.10	124.10	123.90	5.2	5.3	0.54931	0.54682	0.01923	0.57656
1976/77	167.80	281.00	266.67	3.3	4.9	0.67461	0.58921	0.48485	1.35974
1977/78	147.50	176.25	137.17	5.0	3.1	0.19492	-0.07003	-0.38000	-0.42342
1978/79	139.25	151.00	147.93	4.2	4.7	0.08438	0.06233	0.11905	0.18880
1979/80	189.31	180.15	172.88	4.5	4.0	-0.04839	-0.08679	-0.11111	-0.18826
1980/81	128.55	127.45	107.64	5.2	6.1	-0.00856	-0.16266	0.17308	-0.01774
1981/82	129.00	141.09	102.93	4.2	4.2	0.09372	-0.20209	0.00000	-0.20209
1982/83	130.49	125.80	122.25	4.8	4.5	-0.03594	-0.06315	-0.06250	-0.12170
1983/84	135.50	152.43	146.05	3.5	1.4	0.12494	0.07786	-0.60000	-0.56886
1984/85	135.05	147.04	121.33	4.8	4.6	0.08878	-0.10159	-0.04167	-0.13903
1985/86	161.18	230.30	142.15	3.5	4.3	0.42884	-0.11807	0.22857	0.08352
1986/87	169.38	119.23	105.66	4.4	4.7	-0.29603	-0.37620	0.06818	-0.33366

TABLE 6.2. SUMMARY OF MEAN AND OTHER STATISTICS OF FORECAST ERRORS VARIABLE USED

	e_f	e_p	e_q	e_y
Mean	0.12349	-0.01008	-0.00731	-0.00098
Standard Deviation	0.26614	0.26839	0.25990	0.48123
Minimum Value	-0.29608	-0.37620	-0.60000	-0.56886
Maximum Value	0.67461	0.58921	0.48485	1.35974
STD Error of Mean	0.07113	0.07173	0.06946	0.12861
Sum	1.72890	-0.14112	-0.10232	-0.01375
Variance	0.07083	0.07203	0.06755	0.23159
Coefficient of Variation	215.512	2662.624	3556.044	49001.077
Root Mean Square Error	0.32957			

TABLE 6.3. Covariance and Correlation* Matrices Among Forecast Errors

	e_f	e_p	e_q	e_y
e_f	.0708313 (1.00000)*	.0600163 (0.84022)	.0238638 (0.34500)	.0964475 (0.75305)
e_p	.0600163 (0.84022)	.0720325 (1.00000)	.0175891 (0.25216)	0.103859 (0.80412)
e_q	.0238638 (0.34500)	.0175891 (0.25216)	.0675469 (1.00000)	.0961006 (0.76836)
e_y	.0964475 (0.75305)	0.103859 (0.80412)	.0961006 (0.76836)	0.231587 (1.00000)

*Correlation coefficients are in parentheses.

on the cash market, $Cov(e_p,e_q)$ = 0.02, is positive as well as the correlation coefficient, $^{R}e_q$ = 0.25 implying that the producer would have incentive to hedge on the market, quantities greater than expected output (Miller, 1986).

Risk parameters are arbitrarily chosen within the range [0, ∞] and optimal hedging levels are reported for Côte d'Ivoire in Table 6.4. for $\lambda = \infty$; 1,000; 100; 10; 1; 0.1; 0.01; 0.001. When $\lambda = \infty$, the optimal hedging ratio (n*/QF) is equal to the value of the first term of equation (3), i.e. the hedge component since the second term, i.e. the speculative component is zero at that risk level.

For λ between 1 and ∞, the optimal hedging ratios are relatively unchanged at 1.36 indicative that the speculative component is inconsequential for these values of the risk parameter. However, changes occur for λ below 1. For those values of λ optimal hedging diminishes and becomes negative for λ <0.001, i.e. the speculative component becomes greater than the hedging component and thus, the producer is net long in the futures market.

TABLE 6.4. OPTIMAL HEDGING LEVELS FOR ALTERNATIVE RISK AVERSION LEVELS 1974 TO 1987

Risk Parameter	Average Optimal Hedge n*/QF	Standard Deviation
∞	1.362	0.000
1,000	1.362	0.000
100	1.362	0.000
10	1.361	0.000
1	1.360	0.001
0.1	1.345	0.006
0.01	1.192	0.066
0.001	-0.331	0.657

Chapter 7

Summary and Conclusions

The coffee industry has been a very problematic one over the years due to the high volatility in prices as well as in production and consequently producers' income.

The commodity coffee has a very special place in international trade. It is second only to crude oil as an earner of foreign exchange for the coffee producing countries. Coffee is a strategic commodity in commercial relationship between the third world (producers) and the developed countries (most consumers).

Coffee has long been traded on the futures market with increasing but still limited participation of the producers. The reasons for that lack of participation range from mistrust, strict financial requirements, to ignorance. Whatever the real cause, producers need to get more acquainted with futures trading which economic benefits especially the risk reduction function may be a tool to ensure more stable revenues.

This study examines the very dynamic world coffee market in general and the marketing strategies that have been used to solve the coffee problem. Use of futures trading as an additional marketing tool is investigated with respect to Côte d'Ivoire, the third largest (5-6 percent) coffee producer.

A mean-variance model associated with varying levels of the risk aversion parameter and incorporating price as well as production risk is presented. The model is applied to coffee data related to Côte d'Ivoire in order to determine optimal hedging levels for that country on the futures market.

The empirical analysis reveals that a risk averse producer faced with both price and production uncertainties would have incentive to hedge quantities bigger than its expected output if production and cash market prices are positively correlated. In the case of Côte d'Ivoire, optimal hedging levels greater than unity are encountered.

Côte d'Ivoire is a producer that holds a non-negligible amount of coffee stock from year to year. Therefore, application of the result found should be feasible without any greater additional risk. Nevertheless, the study itself could be extended in many ways by taking into account financial and exchange rate risks that could restrain a country from participating to the futures market; also, the quality basis can be eliminated by using the London Coffee Exchange Robusta futures prices.

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APPENDIX A. TYPE OF COFFEE PRODUCED BY MEMBERS OF THE INTERNATIONAL COFFEE ORGANIZATION

Exporting member	Type of coffee
Angola	Arabica, Robusta
Benin	Robusta
Bolivia	Arabica
Brazil	Arabica
Burundi	Arabica
Cameroon	Arabica, Robusta
Central African Republic	Robusta
Colombia	Arabica
Congo	Robusta
Costa Rica	Arabica
Côte d'Ivoire	Robusta
Dominican Republic	Arabica
Ecuador	Arabica
El Salvador	Arabica
Ethiopia	Arabica
Gabon	Robusta
Ghana	Robusta
Guatemala	Arabica
Guinea	Robusta
Haiti	Arabica
Honduras	Arabica
India	Arabica, Robusta
Indonesia	Arabica, Robusta
Jamaica	Arabica
Kenya	Arabica
Liberia	Robusta
Madagascar	Arabica, Robusta
Mexico	Arabica
Nicaragua	Arabica
Nigeria	Robusta
Panama	Arabica
Papua New Guinea	Arabica
Paraguay	Arabica
Peru	Arabica
Rwanda	Arabica
Sierra Leone	Robusta
Tanzania	Arabica, Robusta
Togo	Robusta
Trinidad and Tobago	Robusta
Uganda	Arabica, Robusta
Venezuela	Arabica
Zaire	Arabica, Robusta

Source: ICO, Statistics on Coffee

APPENDIX B. MEMBERS OF THE INTERNATIONAL COFFEE ORGANIZATION

Exporting Members (50)

Angola
Benin*
Bolivia
Brazil
Burundi
Cameroon*
Central African Republic*
Colombia
Congo*
Costa Rica
Côte d'Ivoire*
Cuba
Dominican Republic
Ecuador
El Salvador
Equatorial Guinea
Ethiopia
Gabon*
Ghana
Guatemala
Guinea
Haiti
Honduras
India
Indonesia
Jamaica
Kenya
Liberia
Madagascar*
Malawi
Mexico
Nicaragua
Nigeria
Panama
Papua New Guinea
Paraguay
Peru
Philippines
Rwanda
Sierra Leone
Sri Lanka
Tanzania
Thailand
Togo*
Trinidad and Tobago
Uganda
Venezuela
Zaire
Zambia
Zimbabwe

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*OAMCAF members

Source: ICO

APPENDIX B. Continued

Importing Members (25)

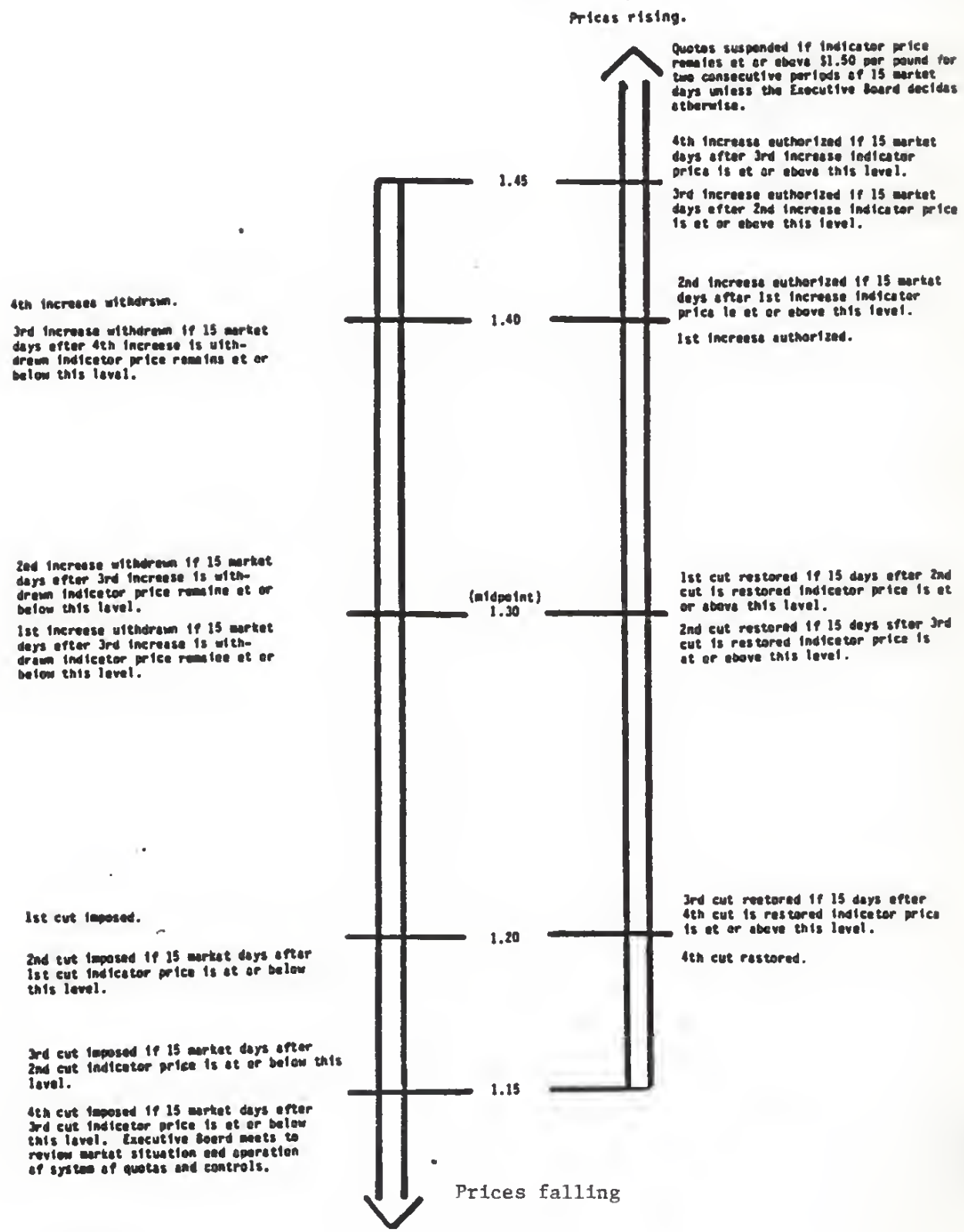
Australia
Austria
Belgium/Luxembourg
Canada
Cyprus
Denmark
Fiji
Finland
France
Germany, Federal Republic of
Greece
Ireland
Italy
Japan
Netherlands
New Zealand
Norway
Portugal
Singapore
Spain
Sweden
Switzerland
United Kingdom
United States of America
Yugoslavia

European Economic Community

Source: ICO

APPENDIX C

INTERNATIONAL COFFEE AGREEMENT PRICE STABILIZATION MECHANISM
15 DAY MOVING AVERAGE INDICATOR PRICE
COFFEE YEAR 81/82
(U.S. DOLLARS PER POUND)



Source: USDA

APPENDIX D.

COMPOSITE INDICATOR PRICES
MONTHLY AVERAGES IN CURRENT AND CONSTANT
APRIL-JUNE 1980 TERMS
1975 TO 1987

(US cents per lb)

Month/year	U.N. index of unit value of exports (April-June 1980=100)	Monthly averages: Current terms 1/	Monthly averages: Constant April-June 1980 terms 2/
	(1)	(2)	(3)
1975	64	62.63f	97.86
January	65	55.08	84.74
February	65	52.94	81.45
March	65	49.85	76.69
April	65	48.33	74.35
May	65	49.19	75.68
June	65	52.64	80.98
July	62	62.18f	100.29
August	62	80.27	129.47
September	62	78.49	126.60
October	61	76.73	125.79
November	61	74.47	122.08
December	61	78.64	128.92
1976	65	135.19	207.98
January	63	85.99	136.49
February	63	90.94	144.35
March	63	90.98	144.41
April	63	115.14	182.76
May	63	128.55	204.05
June	63	139.82	221.94
July	64	131.79	205.92
August	64	143.00	223.44
September	64	148.22	231.59
October	66	162.62	246.39
November	66	179.63	272.17
December	66	205.54	311.42
1977	70	229.21	327.44
January	67	217.61	324.79
February	67	245.93	367.06
March	67	305.13	455.42
April	69	314.96	456.46
May	69	277.41	402.04
June	69	243.06	352.26
July	71	209.00	294.37
August	71	201.36	283.61
September	71	195.78	275.75
October	73	172.48	236.27
November	73	182.13	249.49
December	73	185.70	254.38

f: Frost in Brazil
d: Drought in Brazil
1/ Prices in current terms refer to the average of Other Milds and Robustas up to September 1976, Composite Indicator Price 1976 up to September 1981 and Composite Indicator Price 1979 thereafter
2/ Prices in constant terms refer to prices in current terms deflated by the U.N. index of unit values of exports of manufactured goods from developed market economies (Base: April-June 1980 = 100)

Source: ICO: Coffee Statistics

(Cont'd 1)

COMPOSITE INDICATOR PRICES
MONTHLY AVERAGES IN CURRENT AND CONSTANT
APRIL-JUNE 1980 TERMS
1975 TO 1987

(US cents per lb)

Month/year	U.N. index of unit value of exports (April-June 1980=100)	Monthly averages	
		Current terms 1/	Constant April-June 1980 terms 2/
	(1)	(2)	(3)
1978	80	155.15f	193.94
January	76	191.65	252.17
February	76	186.08	244.84
March	76	166.37	218.91
April	78	161.69	207.29
May	78	152.86	195.97
June	78	159.82	204.90
July	82	130.17	158.74
Auguat	82	133.34f	162.61
September	82	151.12	184.29
October	85	151.89	178.69
November	85	145.21	170.84
December	85	131.58	154.80
1979	91	169.50f	186.26
January	88	130.93	148.78
February	88	127.76	145.18
March	88	132.76	150.86
April	88	140.22	159.34
May	88	148.74	169.02
June	88	190.99f	217.03
July	93	199.78	214.82
August	93	189.70	203.98
September	93	198.36	213.29
October	95	196.97	207.34
November	95	192.19	202.31
December	95	185.63	195.40
1980	101	150.67	149.18
January	98	165.62	169.00
February	98	163.42	166.76
March	98	177.14	180.76
April	100	171.86	171.86
May	100	182.30	182.30
June	100	175.22	175.22
July	104	151.81	145.97
August	104	134.02	128.87
September	104	125.42	120.60
October	102	125.79	123.32
November	102	115.61	113.34
December	102	119.87	117.52

f: Frost in Brazil
d: Drought in Brazil
1/ Prices in current terms refer to the average of Other Milds and Robustas up to September 1976, Composite Indicator Price 1976 up to September 1981 and Compoaite Indicator Price 1979 thereafter
2/ Pricea in conatant terms refer to prices in current terms deflated by the U.N. index of unit values of exports of manufactured goods from developed market economies (Base: April-June 1980 = 100)

(Cont'd 2)

COMPOSITE INDICATOR PRICES
MONTHLY AVERAGES IN CURRENT AND CONSTANT
APRIL-JUNE 1980 TERMS
1975 TO 1987

(US cents per lb)

Month/year	U.N. index of unit value of exports (April-June 1980=100)	Monthly averages	
		Current terms 1/	Constant April-June 1980 terms 2/
	(1)	(2)	(3)
1981	95	115.42f	121.49
January	99	124.93	126.19
February	99	120.18	121.39
March	99	119.93	121.14
April	95	120.57	126.92
May	95	117.15	123.32
June	95	98.59	103.78
July	93	104.13f	111.97
August	93	107.24	115.31
September	93	107.45	115.54
October	97	117.67	121.31
November	97	124.60	128.45
December	97	122.64	126.43
1982	93	125.00	134.41
January	95	124.43	130.98
February	95	134.30	141.37
March	95	129.01	135.80
April	94	124.01	131.93
May	94	120.56	128.26
June	94	121.14	128.87
July	92	115.92	126.00
August	92	117.45	127.66
September	92	122.78	133.46
October	89	128.84	144.76
November	89	130.17	146.26
December	89	131.33	147.56
1983	89	127.98	143.80
January	92	127.24	138.30
February	92	124.35	135.16
March	92	123.14	133.85
April	90	123.00	136.67
May	90	125.82	139.80
June	90	123.80	137.56
July	88	124.20	141.14
August	88	124.93	141.97
September	88	127.11	144.44
October	88	135.52	154.00
November	88	136.95	155.63
December	88	139.72	158.77

f: Frost in Brazil
d: Drought in Brazil
1/ Prices in current terms refer to the average of Other Milds and Robustas up to September 1976, Composite Indicator Price 1976 up to September 1981 and Composite Indicator Price 1979 thereafter
2/ Prices in constant terms refer to prices in current terms deflated by the U.N. index of unit values of exports of manufactured goods from developed market economies (Base: April-June 1980 = 100)

(Cont'd 3)

COMPOSITE INDICATOR PRICES
MONTHLY AVERAGES IN CURRENT AND CONSTANT
APRIL-JUNE 1980 TERMS
1975 TO 1987

(US cents per lb)

Month/year	U.N. index of unit value of exports (April-June 1980=100)	Monthly averages	
		Current terms 1/	Constant April-June 1980 terms 2/
	(1)	(2)	(3)
1984	87	141.19	162.29
January	88	138.32	157.18
February	88	141.11	160.35
March	88	143.18	162.70
April	89	143.89	161.67
May	89	148.36	166.70
June	89	145.43	163.40
July	84	141.01	167.67
August	84	143.13	170.39
September	84	141.85	168.87
October	84	135.99	161.89
November	84	138.14	164.45
December	84	133.89	159.39
1985	87	133.10d	152.99
January	82	135.46	165.20
February	82	133.30	162.56
March	82	132.26	161.29
April	85	132.02	155.32
May	85	131.87	155.14
June	85	131.04	154.16
July	89	120.68	135.60
August	89	119.96	134.79
September	89	118.78d	133.46
October	94	125.93	133.97
November	94	140.91	149.90
December	94	174.84	186.00
1986	105e	170.93	162.79
January	100	204.02	204.02
February	100	195.11	195.11
March	100	204.23	204.23
April	103	191.73	186.15
May	103	176.92	171.77
June	103	151.14	146.74
July	108	149.12	138.07
August	108	154.38	142.94
September	108	181.45	168.01
October	108e	163.21	151.12
November	108e	149.42	138.35
December	108e	130.41	120.75
1987			
January (1-26)	108e	118.30	109.54

APPENDIX E. DERIVATION OF THE OPTIMAL HEDGE n* USING EXPECTED ERRORS FORECASTS

$$R = P.Q + n[PP - PF];$$

$$\Omega = E(R) - \lambda \, var(R)$$

$$Var(R) = Var(P.Q) + n^2 \, Var(PF) - 2nCov(P.Q, PF)$$

if $P = PP(1 + e_p)$

$Q = QF(1 + e_q)$

$PF = PP(1 + e_f)$

Thus $E(R) = E[PP(1 + e_p).QF(1 + eq_)] + n[PP - E(PP(1 + e_f))]$

$$Var(y) = Var[PP(1 + e_p).QF(1 + e_q)] + n^2 Var(PP(1 + e_f))] - 2nCov[PP(1 + e_p).QF(1 + e_q), PP(1 + e_f)].$$

If $\Omega = E(R) - \lambda \, Var(R)$

$$\frac{\partial \Omega}{\partial n} = PP - E[PP(1 + e_f)] - \lambda \, [2nVar[PP(1 + e_f) + 2Cov[PP(1 + e_p).QF(1 + e_q), PP(1 + e_f)] = 0$$

$$2\lambda nVar[PP(1 + e_f)] = PP - E[PP(1 + e_f)] + 2\lambda Cov[\quad].$$

$$n^* = \frac{2\lambda Cov[PP(1 + e_p).QF(1 + e_q), PP(1 + e_f)]}{2\lambda \, Var[PP(1 + e_f)]} + \frac{PP - E[PP(1 + e_f)]}{2\lambda \, Var[PP(1 + e_f)]}$$

given:

$$Var[PP(1 + e_f)] = Var(PP + e_f.PP) = PP^2 \, Var(e_f)$$

$$E[PP(1 + e_f)] = E(PP) + PP.E(ef) = PP + PP.E(e_f)$$

$$n^* = \frac{Cov[PP(1 + e_p).QF(1 + e_q), PP(1 + e_f)]}{PP^2 \, Var(e_f)} + \frac{PP - [PP + PP.E(e_f)]}{2\lambda \, .PP^2.Var(e_f)}$$

$$n^* = \frac{Cov[(1 + ep).QF(1 + e_q), e_f]}{Var(e_f)} - \frac{E(e_f)}{2\lambda \, PP.Var(e_f)}$$

Dividing n* by QF gives us:

$$\frac{n^*}{QF} = \frac{Cov\,[(1 + e_p)(1 + e_q), e_f]}{Var(e_f)} - \frac{E(e_f)}{2\lambda \, QF.PP.Var(e_f)}$$

POTENTIAL USE OF FUTURES MARKETS IN INTERNATIONAL MARKETING OF CÔTE D'IVOIRE COFFEE

by

KOROTOUMOU OUATTARA

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ABSTRACT

Côte d'Ivoire is typical of most coffee producing countries in that it is a less developed country and economically depends very much on coffee exports.

A review of the particular charasteristics of the world coffee economy in general (volatility in prices and quantities, low demand, price and income elasticities), and an overview of the Ivorian coffee marketing in particular, are completed. Emphasis is placed on the problems of the coffee industry that impact income variability in producing countries. Efforts to control income variability through jointly determined marketing quotas and controls are reviewed.

This study also attempts to determine the optimal hedging level for Côte d'Ivoire on the futures market as an additional marketing strategy to insure more stable revenues from coffee exports. A Mean-Variance model is used which incorporates price and production risks for that purpose.

The results indicate that a risk averse producer country would hedge more than 100 percent of its production if cash prices and quantity are positively correlated as is the case with Côte d'Ivoire.